THE PORT OF HAMBURG

NUNC COGNOSCO EX PARTE

TRENT UNIVERSITY
LIBRARY

THE PORT OF HAMBURG

£15

With compliments of

Johs. Gräpel & Penzhorn

Stevedores

Office for Superintending, Sampling,
Checking of Weights

HAMBURG 11.

Digitized by the Internet Archive
in 2019 with funding from
Kahle/Austin Foundation

https://archive.org/details/portofhamburgwit0000wend

THE PORT OF HAMBURG

WITH PLANS, CHARTS AND NUMEROUS ILLUSTRATIONS

BY

DR. ING. L. WENDEMUTH
OBERBAUDIREKTOR, WASSERBAUDIREKTION, HAMBURG

AND

DIPL. ING. W. BÖTTCHER
BAURAT, KAIVERWALTUNG, HAMBURG

ISSUED BY THE

DEPUTATION FÜR HANDEL,
SCHIFFAHRT UND GEWERBE

AND THE

BAUDEPUTATION, SEKTION
FÜR STROM- UND HAFENBAU

HAMBURG
MEISSNER & CHRISTIANSEN / PUBLISHERS
1927

TC 274 .H3 W4

Translated from the German by

WILHELM EGGERS

Master of Arts (University of London)
Sworn Translator.

The photographs illustrating this book were supplied by:

(1) The Wasserbaudirektion, Hamburg.
Nos. 7, 9, 12, 15, 19, 24, 25, 26, 27, 29, 30, 31, 32, 33, 34, 37, 38, 43, 44, 47, 49, 63, 65, 70, 72, 75, 76, 80, 81, 82, 83, 85, 86, 87.

(2) The Hamburg-Amerika Linie, Hamburg.
Nos. 10, 16, 23, 28, 55, 56, 61, 68, 78, 79, 84.

(3) Photographisches Atelier Otto Reich, Hamburg.
Nos. 8, 13, 14, 35, 36, 39, 54, 57, 58, 59, 60, 62, 66, 67, 69, 74, 77.

(4) Photographisches Atelier L. & A. Schaul, Hamburg.
Nos. 5, 6, 11, 22, 71, 73.

Printed by J. J. Augustin, Glückstadt and Hamburg.

CONTENTS.

The Port of Hamburg.

Section One.
The Foundations for the Development of the Port of Hamburg.

The Position of Hamburg in relation to neighbouring European Ports .. 1
The Position of Hamburg in relation to the Sea .. 2
The Importance of the Elbe as a Waterway .. 3
The Network of Waterways linked up with Hamburg .. 3
The Waterways as Carriers of the Goods Traffic .. 8
The Improvement of Navigation on the Upper Elbe .. 9
The Hansa Canal .. 11
The Position of Hamburg in relation to the Continental Railway System .. 12
The Extent of the Hinterland .. 14
The Sea-borne Traffic of the Port of Hamburg .. 14
Some Additional Factors contributing to the Development of the Port of Hamburg .. 17

Section Two.
General Description of the Harbour Plan.

General Topography of the City-State of Hamburg .. 19
Topography of the Harbour Area .. 20
The Intersection of the Harbour Area by Water Courses .. 21
The Intersection of the Harbour Area by the Railway Line and the Bridges .. 23
The Map of the Port of Hamburg .. 24
General Design of the Harbour .. 25
The Principle of Harbour Basins cut into the Land .. 26
The Principle of Open-Basin Harbours .. 26
General Features of the Harbour Basins .. 27
Loading and Discharging Facilities .. 28
The Basins for Sea-going Vessels .. 31
The Basins for Rivercraft .. 36
The Canal System .. 38
The Goods Sheds used in connection with River-borne Traffic .. 40
The Locks .. 41
The Warehouses .. 43
Railway Facilities .. 46
Road Traffic in the Harbour .. 53
The Facilities for Passenger Traffic .. 54
The Free Port and the Customs Facilities .. 57
The Industries domiciled in the Port .. 61
Facilities for Special Purposes .. 69

Section Three.
Harbour Works and their Mechanical Equipment.

The Quays .. 78
The Quay Walls .. 80
The Quay Sheds .. 83

82503

Quay Equipment .. 90
The Cranes .. 91
Mechanical Equipment used in the Quay Sheds .. 99
Equipment for Short-Distance Transports .. 100
Equipment for Piling up Cargo .. 103
Weighing Machines .. 106
Coal Tipping Devices .. 106
Mechanical Equipment used for Midstream Transhipment .. 107
The Warehouses .. 108
Shore Protection .. 110
The Locks .. 110
The Dolphins .. 111
The Landing Places .. 113
The Customhouse Clearing Stations .. 115
The Köhlbrand Train Ferry .. 116
The Bridges .. 119
The Elbe Tunnel .. 122

Section Four.
The Historical Development of the Port of Hamburg.

I. From the Earliest Times to the Completion of the First Quay .. 129
II. From the Foundation of the United German Empire to the World War .. 147
III. From the World War to the Present Time .. 157

Section Five.
The Organisation of the Harbour Services.

State Operation and Private Operation .. 169
The Public Authorities connected with the Port of Hamburg .. 170
Private Organisations connected with the Harbour Services .. 182
The Harbour Fees charged by the State .. 188

Section Six.
The Course of the River Elbe from Hamburg to the Sea.

The Upper, Northern and Southern Elbe .. 190
The Lower Elbe .. 194
Dredging .. 200
The System of Marking the Navigable Channel .. 204

Section Seven.
The Port of Cuxhaven. 208

Section Eight.
Some Statistical Data. 217

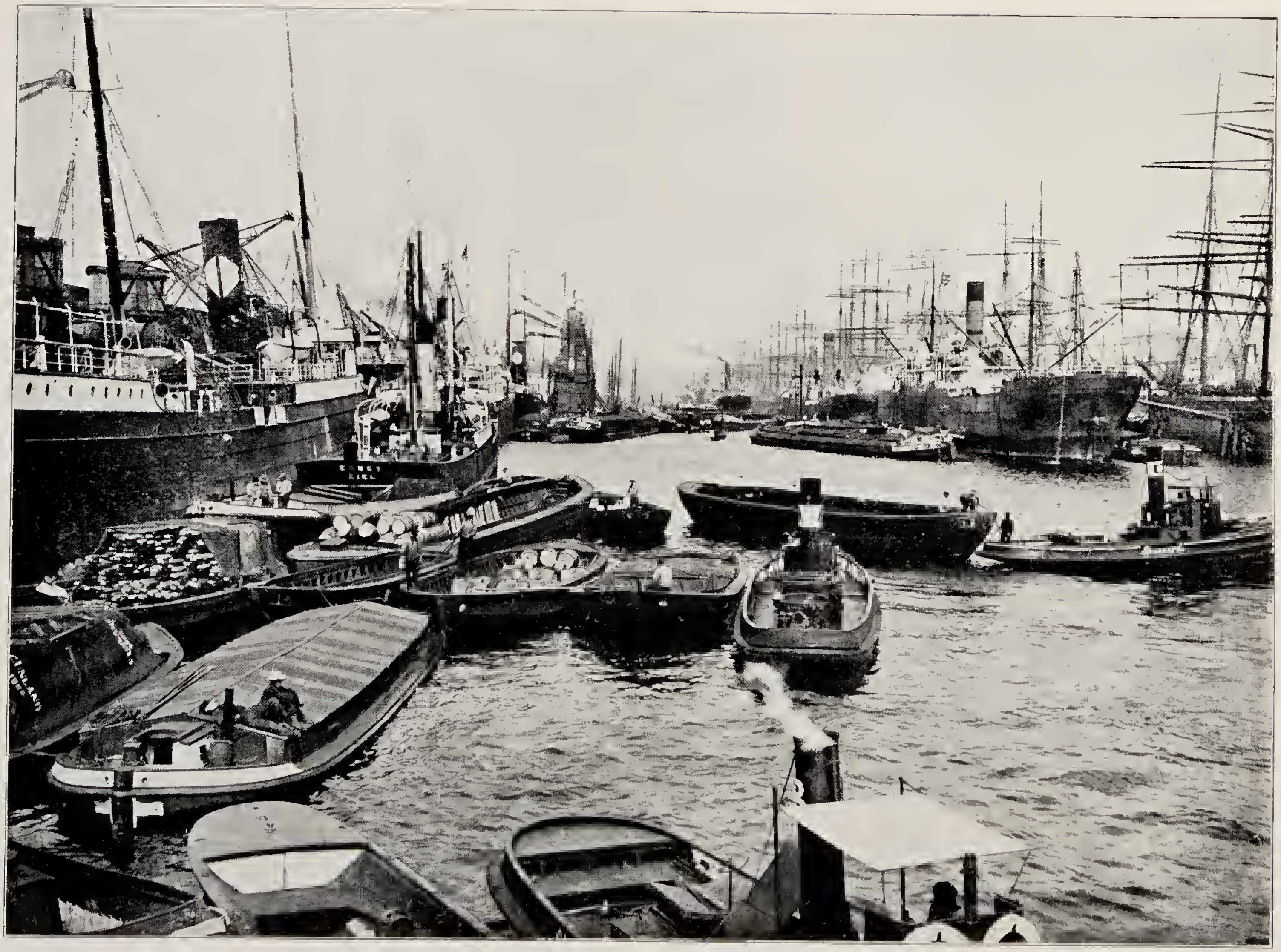


Fig. 1. View of Segelschiffhafen.

SECTION ONE.

The Foundations for the Development of the Port of Hamburg.

Hamburg forms the most easterly link in the chain of great North Sea ports that constitute the gates through which a considerable percentage of the trade between Europe and the overseas countries must necessarily pass, and there can be no doubt that this fact has very largely contributed to her position as an important centre of international traffic. It is therefore proposed to briefly review her geographical situation before giving a detailed description of her port and its equipment.

★

The Position of Hamburg in relation to neighbouring European Ports.

The south-eastern corner of the North Sea is the terminus of one of the world's most important highways of commerce. Trade routes emanating from all quarters converge there, and the ocean-going ships, after entering the wide and deep estuary of the Elbe, proceed up-river for about 62 miles until they discharge their cargoes at Hamburg (cf. Map No. I). In both directions — eastbound and westbound — there is ample opportunity for them to supplement their cargo and to discharge part of it *en route* without any serious loss of time. They are thus able to collect goods for their return trips at intermediate ports, which materially enhances their freight-earning capacities. The proximity of Hamburg to other large seaports facilitates the proper stowage of cargoes with due regard to weight. It frequently happens that westbound vessels call at one or other of these ports to take in some cargo and that they return to Hamburg before entering upon their actual voyage. This circumstance, more perhaps than any other, illustrates the interdependence of the seaports forming the North West European group. Compared with the distances the ships have to cover on the highroads of the oceans, those between the various North Sea ports are of no account whatever. International trade has caused the development of economic areas independent of political boundaries, and as Hamburg, in conjunction with the other North Sea ports, has shared in this development, it is obvious that she has thereby helped her hinterland to acquire additional markets throughout the world.

★

The Position of Hamburg in relation to the Sea.

The close proximity to Hamburg of the other large seaports, however, has also given rise to a struggle for the possession of the industrial hinterland. Such struggles are inherent in the very nature of commercial enterprise, and there is therefore nothing unhealthy about them. The weapons employed in fighting them out are not restricted to endeavours aiming at an increase in port efficiency, but also comprise the various efforts made to utilise most profitably the existing geographical advantages.

Here, again, the determining factor is the position of the port in relation to the sea. The freight rates for the carriage of goods depend to a limited extent only on the length of the ocean voyage. As soon as a vessel has entered the estuary of the river on which the port she is making for is situated, she has to compete with the railroad as a freight carrier, and after that the distance factor acquires much greater importance than before.

The fact that the sea route to Hamburg is longer than that to other North Sea ports might at first sight be looked upon as a disadvantage, but it is really a great advantage in favour of Hamburg, and has greatly benefited the development of her foreign trade. The major part of ocean-borne cargoes is not destined for the ports where the sea voyage terminates, but for places situated in the interior of the country, and railroads and rivercraft have to carry them to their final destinations. The transport charges per mile, however, made by the on-carriers are many times higher than those made by the ocean carriers. In fixing the on-carrying rates, especially those charged by the railroads, almost every mile forms an important consideration, whereas in the case of the ocean freight rates it often happens that a difference of several hundred miles is left out of account. The prosperity of a seaport very largely depends on the extent of its hinterland which, in its turn, is partly determined by the rate policy of the on-carriers. For these reasons Hamburg has spared no efforts and no money to extend the navigability of her river as far up-stream as geographical conditions permit, thus shortening in like measure the length of the route on which the merchandise is subject to the higher rates of freight.

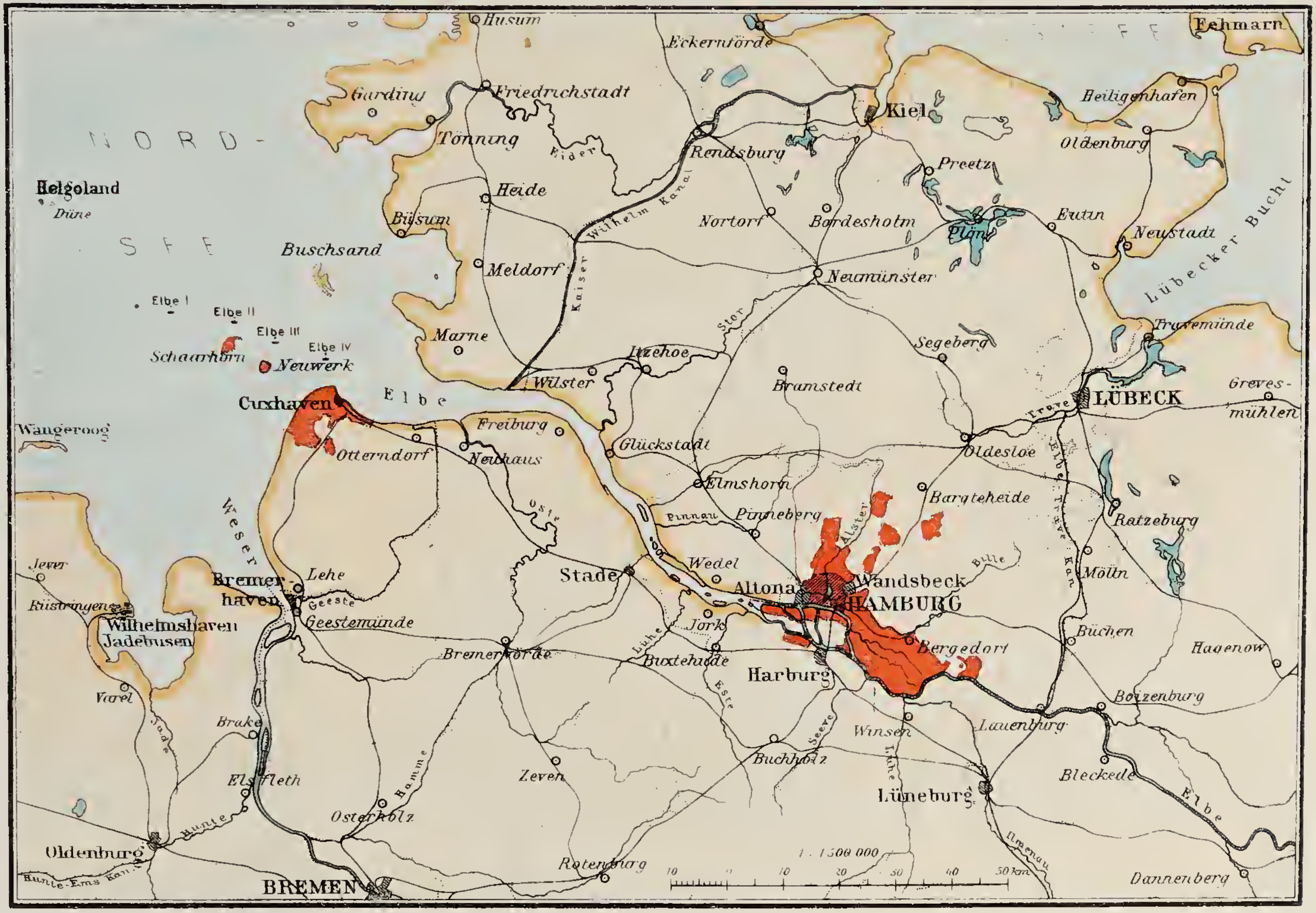
Few of the large Continental seaports are situated so close to the heart of Central Europe, to its densely populated manufacturing areas, to its important mining and agricultural centres, and to its flourishing commercial emporiums, as Hamburg. Her extensive hinterland is not limited by any political frontiers, and all parts of it benefit from the favourable freight rates she can offer. Her situation in regard to the sea has enabled her to acquire a position which permits her to extend the sphere of her influence in every direction.

★

Reference Note to the accompanying Map No. I.: The Position of the Hamburg State area (indicated by a red tint) in relation to the North Sea and the Baltic.

Wasserbaudirektion Hamburg. 1927.

I.



Bearbeitet im Kartographischen Bureau der Wasserbaudirektion Hamburg

Druck von Jagdmann u. Kohm, Hamburg 8

The Importance of the Elbe as a Waterway.

The advantages Hamburg has derived from her maritime position are considerably augmented by those derived from her situation on the River Elbe. The mere fact that the transfer of cargo from the ocean-going vessel to the inland carrier is effected at a place situated a long distance from the sea does not by itself satisfy the demand that the cost of transportation should be as low as possible. The Upper Elbe, with its numerous tributaries and canal connections, is a waterway of very considerable practical importance and supplements the advantages already described. Railroads, indeed, are indispensable for the carrying of certain kinds of high-class piece goods — e. g., perishables — that can stand high freight rates, but cannot stand any delay in transportation. For bulk goods, however, they cannot, as a rule, successfully compete with rivercraft. For technical reasons and for considerations of remunerativeness it is difficult for them to carry merchandise to and from a seaport in such quantities as to permit its development into a first-class transhipment centre.

Large quantities of imported goods that would not be attracted to a port connected with the interior by railroads only find their way to Hamburg because they can there be transhipped to rivercraft. In like manner the excellent system of waterways which extends far into the hinterland attracts to Hamburg numerous goods intended for export. At a time like the present when the fight for economic spheres of influence by means of preferential railway rates has become exceedingly keen, Hamburg has every reason to appreciate the importance of its vital traffic artery, the Elbe, as a carrier of merchandise. Every artifical device meant to deviate goods from their natural route down the Elbe is, and always has been, bound to fail. The Elbe, therefore, like every other suitable natural waterway, largely contributes to the stability of Central European trade conditions, and it is the task of Hamburg to act as the connecting link between the vast area served by the Elbe and its canal system on the one hand and the world's markets on the other.

★

The Network of Waterways linked up with Hamburg.

The following brief description shows how far the area served by the Elbe and its connecting waterways extends, and which are the industrial districts tapped by them. Reference is made to the accompanying Map No. 11 on which the system of navigable watercourses with which Hamburg is connected has been indicated by a blue tint.

Technically, the spot where the "Elbe 1" lightship — the first lightship encountered by an incoming ship — and the buoy marked "Elbe" are anchored is spoken of as the mouth of the Elbe. This spot is situated about 85 miles below Hamburg, and about 22 miles below Cuxhaven. Between Cuxhaven and Hamburg we find a whole series of river ports in Prussian territory, some of which — e. g., Altona — lie on the Elbe itself, whilst others link up with the main river by short and narrow tributaries. Since all these ports maintain a considerable local traffic with Hamburg, they may be said to form integral parts of the large harbour area of the Elbe estuary.

Within the Port of Hamburg the River Elbe divides into two main branches, called Northern Elbe *(Norderelbe)* and Southern Elbe *(Süderelbe)* respectively. The Northern Elbe is 10 miles long. On it are situated the city of Hamburg with its harbour basins and, adjoining it on the western side, the Prussian city of Altona. The Southern Elbe is slightly longer than the Northern branch. It flows past the Prussian city of Harburg. Its lower section belongs to Hamburg and is called Köhlbrand. The two branches are joined by the Reiherstieg which is just under 5 miles long. It flows past the Prussian port of Wilhelmsburg, and its lower section again belongs to Hamburg.

The most important tributaries of the Northern Elbe on its right bank are the Alster, the Bille, the Dove Elbe, and the Gose Elbe. Each of them carries a brisk local traffic. The Kiel Canal *(Kaiser Wilhelm-Kanal)* however, which branches off from the Lower Elbe near Brunsbüttel forms a waterway of the highest importance to the international traffic issuing from and converging upon Hamburg. This artificial shipping highroad relieves vessels of the long and cumbersome passage round the peninsula of Jutland and enables them to proceed from the North Sea to the Baltic and *vice versa* by the shortest possible route. Its junction with the Elbe lies only 44 miles below Hamburg. Since its completion the latter port has become more than ever the intermediary between the Baltic countries and the nations across the sea. The export and import statistics clearly shew how the building of the Canal has affected the trade of Hamburg in this regard. For instance, the figures for her outgoing trade to Baltic ports — which amounted to 6½% of her total, and 10% of her European trade previous to 1895 (when the Canal was opened) — have since then gone up to 11% and 21% respectively. The Kiel Canal between the locks at Brunsbüttel and those at Holtenau has a length of about 62 miles.

The part of the River Elbe above the Port of Hamburg is called Upper Elbe *(Oberelbe)*. Early in the Middle Ages the trade following the route of the Elbe did not gravitate towards Hamburg, but towards Bardowiek. In those days and previous to its destruction by Duke Henry the Lion, Bardowiek was able to attract shipping to its very gates. It lies below Lüneburg on the river Ilmenau which flows into the Elbe about 16 miles above Hamburg and is navigable from its mouth up to Lüneburg, a distance of 17 ½ miles.

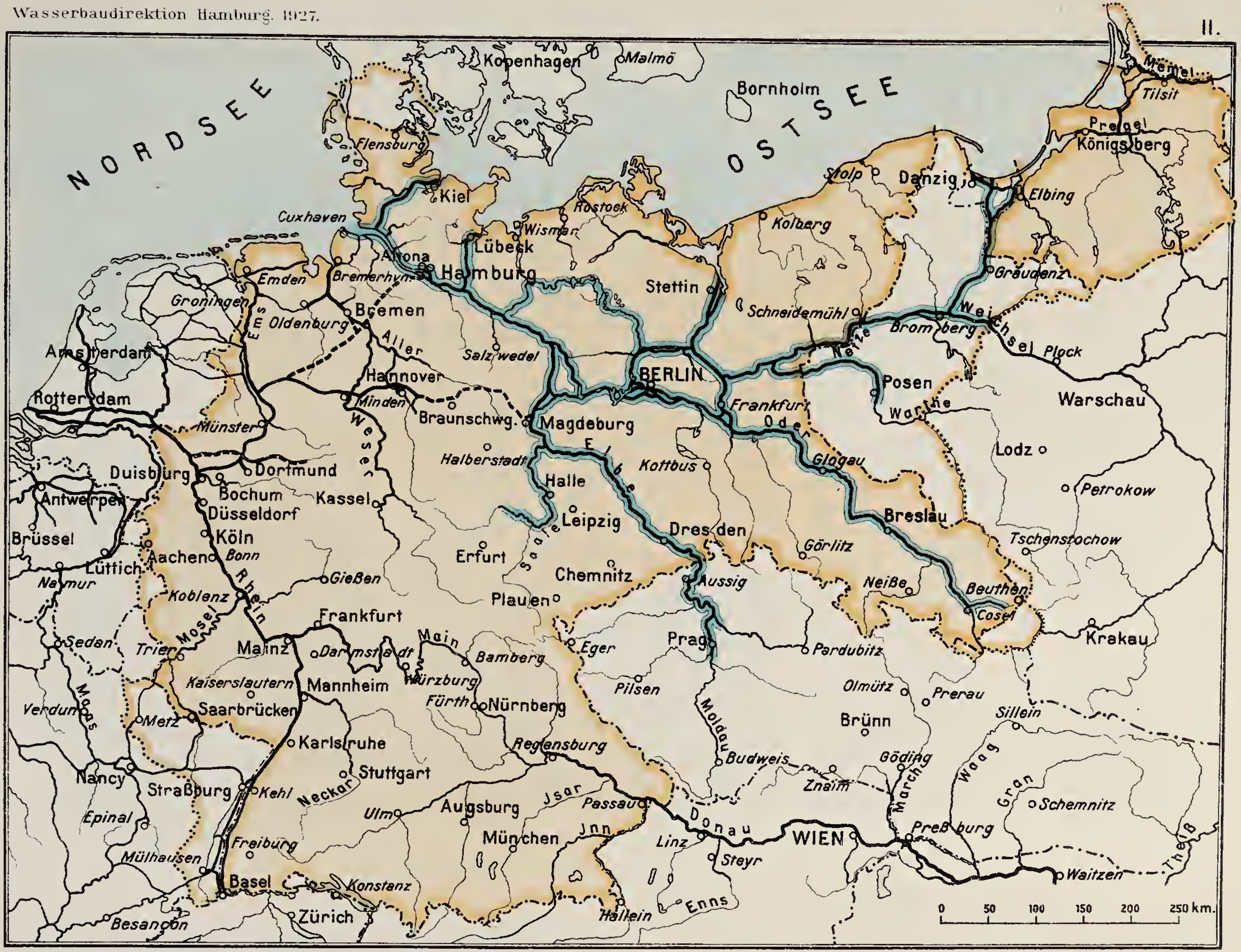
An additional direct connection between the Elbe and the Baltic, apart from the Kiel Canal, is the Elbe-Trave Canal which links up the small city

---

Reference Note to the accompanying Map No. II.: The Waterway Connections between Hamburg and her Hinterland. The waterways connected with Hamburg are marked in blue. The projected Hansa Canal — which is intended to join Hamburg and the Midland Canal *via* Bremen — and the projected extension of the latter canal from Hanover to Magdeburg are indicated by dotted lines.

Wasserbaudirektion Hamburg. 1927.

II.



Bearbeitet im Kartographischen Bureau der Wasserbaudirektion Hamburg.

Druck von Jagdmann u. Behm. Hamburg 8.

of Lauenburg (34 miles above Hamburg) with Lübeck and its outer harbour of Travemünde on Lübecker Bucht. It is 42 miles long, and is navigable for the largest kind of Elbe barges and for sea-going lighters. As it intersects the harbour basins of Lübeck, it forms a valuable connection between this ancient seaport and the Elbe region.

The next important tributary of the Elbe on its left bank is the Jeetzel which is navigable for about 28 miles as far as Salzwedel.

The waterway connection between the Elbe and the two free states of Mecklenburg — both of them famous for their agricultural products and for their excellent breeds of cattle — is effected by the Elde-Wasserstrasse. This system of waterways, of which nearly 150 miles are navigable, links up with the Elbe near Dömitz, its principal parts being the River Elde and the chain of Mecklenburg lakes. It serves Schwerin and joins up with the upper reaches of the River Havel as well as with the Brandenburg system of waterways *(Märkische Wasserstrassen)* around Berlin.

The River Havel itself flows into the Elbe about 120 miles above Hamburg, near Werben. The city of Wittenberge, one of the principal river harbours on the Elbe, lies several miles below the mouth of the Havel. The latter tributary not only connects the main river with Berlin, but also, by way of various canals, with the River Oder. This means that in the area served by these waterways the North Sea port of Hamburg competes with the Baltic port of Stettin, for the cargo traffic moving to and from it. We have already come across a similar instance of competition — that time between Hamburg and Lübeck — when we mentioned the Elbe-Trave Canal.

Below the ancient city and river port of Tangermünde the Elbe has a second and a third canal connection with the network of Havel waterways in the Plaue Canal and the Ihle Canal which branch off from it about 156 and 174 miles above Hamburg respectively. The Brandenburg waterways and their Eastern continuation will be touched upon in a subsequent part of this chapter. For the present we continue our description of the Elbe and its more direct connections.

About 187 miles above Hamburg the Elbe passes through the city of Magdeburg, another very important centre of the area whose principal trade route is the river. Magdeburg has had intimate commercial relations with the Port of Hamburg since the earliest days of its history. Just above it, near the mouth of the Saale, there are three other important transhipment centres, viz., Schönebeck, Barby, and Aken. These, like Magdeburg, are in the Prussian province of Saxony.

Next to the Havel the Saale is the principal German tributary of the Elbe as regards traffic. Its junction with the main river lies about 208 miles above Hamburg. It is navigable for 110 miles up to the point where the River Unstrut flows into it, near Naumburg. Its banks are lined with numerous industrial establishments and with some important transhipment places for rivercraft. The principal cities along its course are Halle, Weissenfels, and

Merseburg in Prussia, and Bernburg in Anhalt. The River Unstrut, too, is extensively utilised for industrial and shipping purposes. About 45 miles of it are navigable, its navigability extending as far as the foothills of the Hartz Mountains and of the Thuringian Forest.

Just above the mouth of the Saale the Elbe flows through the territory of the free state of Anhalt. The Anhalt river ports of Dessau, Wallwitzhafen, Leopoldshafen, and Rosslau considerably contribute to the volume of traffic moving up and down the river.

The principal ports on the next section of the river, where it flows through Prussian territory again, are Wittenberg and Torgau, and those in the free state of Saxony are Strehla, Riesa, Meissen, Pirna, and Dresden (356 miles above Hamburg), the latter city being the capital of the country.

About 390 miles above Hamburg the national frontier of Germany crosses the course of the Elbe, and we enter the territory of Czecho-Slovakia, a country which supplies the world with an abundance of industrial and agricultural products. The natural outlet of large parts of its area towards the sea is the Elbe, and therefore the Port of Hamburg. Its principal Elbe ports are Tetschen, Bodenbach, Aussig, Lobositz, Leitmeritz, and Melnik. The navigability of the main river itself comes to an end near the last-named place (about 456 miles above Hamburg). The Moldau, however, a tributary joining the Elbe at Melnik, is navigable as far as Prague. Even beyond Prague there is still a certain amount of river traffic, but this is of little importance.

On the long section between the mouth of the Saale and its source the Elbe is not joined by any navigable tributary exept the Moldau, neither are there any canal connections. The highly productive industrial districts of Leipzig and Chemnitz to the left, and the Lausitz industrial district to the right of the river, are therefore exclusively dependent on railroads for their connection with the Elbe as a traffic highway. This circumstance explains why there are so many river ports along the section concerned, the places mentioned above being only the most important out of a far larger number.

It has already been pointed out that the district around Berlin, as compared with the industrial districts of Saxony, enjoys the advantage of having a very extensive direct connection with the Elbe by means of numerous waterways.

This connection is effected by the River Havel and the above-mentioned Ihle-Plaue Canal — two waterways which join near Brandenburg — in conjunction with the River Spree. The latter flows into the Havel near Spandau. The complete system not only serves the traffic needs of the city of Berlin, but also those of large parts of Eastern Germany and the countries beyond the German frontier. Two very efficient canals, for the construction of which natural river courses have partly been drawn upon, join Berlin to the River Oder. One of them is the Oder-Spree Canal which has taken the place of the older Friedrich-Wilhelm Canal and whose junction with the Oder is at Fürstenberg (320 miles above Hamburg). It is of importance in connection with the river traffic to and from Silesia. The distance along the Oder from Fürstenberg to Breslau is about 185 miles, that to Ratibor — the place where navigation ends — about 310 miles, and that to Gleiwitz (situated on the Klodnitz Canal which branches off from the Oder near Kosel) about 311 miles. The second canal above referred to starts at Spandau, utilises the upper course of the Havel to some extent, and joins the Oder at Hohensaathen (Hohenzollern Canal). The distance from Hamburg to Hohensaathen is about 284 miles, and that from Hohensaathen down the Oder to Stettin another 46 miles. The whole of the canal system just outlined — consisting of two pairs of waterways all converging towards Berlin from the east (Oder) and the west (Elbe) respectively — is supplemented by more than thirty minor waterways branching off from the principal ones. The most important of them, from the point of view of river transportation to and from Hamburg, is the Teltow Canal, by using which river barges proceeding from the Elbe to the upper reaches of the Oder or *vice versa* can avoid Berlin by a more southern route, thus shortening the distance to be covered and accelerating the voyage.

However, neither Berlin nor the Oder districts constitute the utmost limit to which river navigation to and from Hamburg extends. Communication with the parts still further east is established by the River Warthe, the longest tributary of the Oder, which joins the main river about midway between the Havel-Oder and the Spree-Oder connections near Küstrin. It is navigable far beyond Posen, a distance of nearly 270 miles. Near Landsberg it receives the Netze, and this tributary in conjunction with the Bromberg Canal and the River Brahe effects the connection with the Vistula *(Weichsel)*. The length of this important waterway, by which the Oder is joined to the Vistula, is just over 184 miles. The distance from its junction with the Vistula to the mouth of the latter river near Danzig on the Baltic is 120 miles, whereas the up-river distance between the same point and Thorn is 22 miles.

Beyond the former eastern frontier of Germany the Vistula and its tributaries — some of which are of considerable length — are not much utilised for purposes of river transportation. They are largely used for rafting, and are therefore of little practical importance from the point of view of the Port of Hamburg.

The following list shews the distances between Hamburg on the one hand, and the inland termini of river navigation, etc., on the other:

From	Hamburg	to Cuxhaven	62	miles
,,	,,	,, Kiel	106	,,
,,	,,	,, Lübeck	76	,,
,,	,,	,, Magdeburg	187	,,
,,	,,	,, Halle	275	,,
,,	,,	,, Dresden	356	,,
,,	,,	,, Prague	487	,,
,,	,,	,, Berlin	231	,,
,,	,,	,, Stettin	331	,,

From Hamburg to Breslau	506 miles
,, ,, ,, Gleiwitz	630 ,,
,, ,, ,, Danzig	620 ,,
,, ,, ,, Thorn	520 ,,
,, ,, ,, Posen	462 ,,

★

The Waterways as Carriers of the Goods Traffic.

Without the network of waterways just described which is linked up with Hamburg by the Elbe and which affords easy communication not only with the highly productive districts of Northern, Central, and Eastern Germany, but also with considerable portions of some neighbouring countries, trade intercourse between Hamburg and her hinterland could never have become as intimate as it actually is. It is a general rule that the rates for water transportation are lower than the freight charges made by the railroads, and the difference between the two is an important consideration where such long distances as appear in the preceding list are concerned. This consideration applies with particular force to the traffic in bulk goods like coal, ore, mineral earths, timber, and building stones, which form 75% of the goods carried by the waterways of Germany. The waterways in their turn exercise a considerable influence upon the rail traffic, as is most clearly shewn by the fact that there are no less than 132 more or less important river ports in Germany, all of which are equipped with extensive facilities for transhipment from barge to railroad and *vice versa*. As many as 52 of them are situated on the waterways connected with Hamburg, this figure being exclusive of numerous minor transhipment places, both private and public. Elsewhere we shall have to investigate the question of how far the hinterland of the Port of Hamburg is capable of extension by the railroads connected with the waterways referred to.

In this place it may be permitted to add a few statistics concerning the network of waterways previously described. Their length is 3,850 miles, or not much less than half the total length of all the waterways constructed with the aid of German capital (9,000 miles). It is obvious, of course, that the extent to which Hamburg participates in the goods traffic moving on the waterways linked up with it is in an inverse proportion to the distances concerned, and that the influence of the competing seaports, viz., Lübeck, Stettin, and Danzig, is most marked where the distances from Hamburg are longest. Nevertheless, the traffic between Hamburg and the Havel system of waterways in 1926 amounted to 17.5%, and that between Hamburg and the Oder and the still more remote destinations to 7.5% of the entire river-borne goods traffic moving to and from Hamburg, so that 75.0% of this total are contributed by the traffic moving on the Elbe and its more direct connections.

The aggregate amount of goods carried on the German waterways in 1925 was 85.6 million tons, 9.4 millions of which were carried on the Elbe. Hamburg's contribution to these amounts was 6.7 million tons, which represents about 71% of the Elbe traffic, and about 8% of the total traffic on all German waterways.

It has already been stated that more than 130 river ports share in this traffic. In 1924 Hamburg occupied the third position among them, taking for a basis of comparison the volume of goods transhipped to and from river barges. The two ports taking precedence of Hamburg were Duisburg-Ruhrort, the biggest of all German river ports, and Mannheim. The amount of goods handled at Duisburg-Ruhrort was about four times that handled at Hamburg, but this high figure was principally due to coal shipments. The river-borne traffic of Mannheim exceeded that of Hamburg by 20%, whereas that of Berlin, the fourth largest river port, fell short of that of Hamburg by 10%, and that of Alsum-on-the-Rhine, the fifth largest, by 20%. As regards the other river ports of Germany, the traffic moving from Hamburg exceeded that moving from Kosel (Oder) and Emden (Dortmund-Ems-Canal), by 250%, that moving from Stettin (Oder) and Walsum (Rhine) by 350%, that moving from Ludwigshafen (opposite Mannheim) and Cologne by 400%, that moving from Frankfort-on-Main by 500%, and that moving from Mainz by 600%.

In 1924 the goods traffic of Hamburg carried by inland waterways was distributed as follows:

Prussian province of Saxony	23.6%
Prussian province of Brandenburg, including Berlin	23.3%
Czecho-Slovakia	21.1%
Free state of Saxony	11.8%
the Mecklenburgs and Schleswig-Holstein excluding the Lower Elbe district	9.0%
Prussian province of Silesia	4.3%
Lower Elbe district	3.2%
Prussian province of Hanover and free state of Oldenburg	1.8%
Rhine ports	1.2%
German Eastern Marches (*Ostmark*) and Poland	0.4%
Prussian province of Pomerania	0.3%

* * *

The Improvement of Navigation on the Upper Elbe.

In view of the importance of the Elbe in connection with the goods traffic handled at Hamburg, the government of the city-state has spared no efforts to ensure that all possible improvements to aid navigation on the Upper Elbe were carried out. Compared with the other German and non-German riverain states its own share in the actual possession of the latter is very small, but its economic interests in the territory of which the Elbe is the chief artery of water-borne traffic is very considerable, as the foregoing statistics have amply shewn. The Elbe Navigation Act of 1821, drawn up by the interested governments, and the Additional Act of 1844 had already fixed a minimum depth for the whole river, but owing to the increasing size of the up-river barges the arrangements then made soon proved unsatisfactory. By the German Shipping Dues Act of 1911 the minimum depth below the lowest water level on record was fixed at 3 ft 7 ins for the part above, and at 4 ft 1 in for the part below the mouth of the River Saale. Such a depth will enable the 1,000-ton river barge — which is by no means rare on the Elbe — to be used everywhere. Even now barges having a capacity exceeding 1,000 tons are frequently met with on the river. The towboats employed are also constantly increasing in number and size, the largest of them having 1,200 indicated horse power. Towing has been the rule for a long time past, and trains of barges carrying cargoes up to 4,000 tons are nothing unusual. The towing chain which was formerly used has now disappeared everywhere except in some parts above the mouth of the Saale, but even there it is more and more dispensed with. Transportation on the Elbe greatly benefits from the circumstance that up to Leitmeritz locks are entirely absent.

The following figures clearly indicate the value of the Upper Elbe as a carrier of goods to and from the Port of Hamburg. In 1924 about 21% of the total goods traffic in Germany (receipts and shipments) used the waterways, and about 79% the railroads, whereas the corresponding figures for the goods trade to and from Hamburg (excluding ocean-borne trade) for the same year were 45% and 55% respectively. Before the war the preponderance of the river-borne traffic to and from Hamburg over the rail-borne trade was even more pronounced. The figures for the whole of Germany were then: 15% water-borne, and 85% rail-borne, whilst those for Hamburg were: 62% water-borne, and 38% rail-borne traffic. It may therefore be assumed that the relative positions occupied by the two kinds of carriers will tend to revert to what they formerly were, once the economic condition of the country has become normal again.

The fact that 62% of the goods traffic between Hamburg and her hinterland could choose the waterway route, and the further fact — already alluded to — that at least 75% of the river-borne cargo consists of bulk goods, go far to prove that the development of Hamburg into an international seaport of the highest rank is very largely due to the river on which she lies. It was therefore necessary to preface the present appreciation of the Port of Hamburg by a preliminary glance at its position in relation to the Elbe.

★

The Hansa Canal.

The Hamburg authorities did not fail to draw the necessary inferences from the position described above. They considered it unsatisfactory that the only waterway connections of their port — which enjoys so favourable a situation towards the sea and attracts to itself so considerable a traffic from overseas — should be those linking it up with the Eastern part of the German system of waterways. The total length of all the navigable waterways in Germany is about 9,000 miles, 5,200 of which fall to the share of the Weser, Ems, Rhine, and Danube systems. Up to now there is no waterway connection between Hamburg and the areas served by these rivers. The consequence is that a large part of the Central European goods traffic, which, in accordance with sound economic principles, ought to find its way to the Port of Hamburg, is deviated elsewhere in defiance of these principles, or is compelled to make use of the railroads in order to reach it, although transportation by water would be far more appropriate to the nature of the merchandise. Hamburg, therefore, finds herself confronted with a state of things that has prevented considerable economic forces available in her own hinterland and elsewhere from being utilised to their maximum extent. For reasons akin to those by which she was influenced herself, other centres of German trade and traffic have also come to feel the inadequacy of the existing facilities for waterway connection.

Hamburg, therefore, has always watched with keen interest the various projects aiming at an extension of the German canal system, and has lent her special support to those intended to supply the much-needed connection between the west and the east of Germany. The chief economic area with which she, to the great disadvantage of the country as a whole, is not connected by an inland waterway of any kind, is the mining and manufacturing district of the Rhineland and Westphalia.

The so-called Midland Canal *(Mittelland-Kanal)*, i. e., the artificial waterway of which the section from the Rhine to Hanover *via* the Ems and the Weser has already been completed, and which is to be extended to a place on the Elbe near Magdeburg, cannot be regarded as a satisfactory solution of the problem from the Hamburg point of view. The détour *via* Magdeburg is so long that it will not offer a sufficient inducement to shipping to make use of the Port of Hamburg.

Hamburg, therefore, has done all she could to support the projected canal connection between the Rhineland and Hamburg by the shortest practicable route *via* Bremen — a connection recommended by numerous economic organisations. The projected canal is to be known as the Hansa Canal if the scheme materialises.

As shewn in Map No. II, the Hansa Canal is intended to link up the western part of the existing Ems-Weser Canal (Midland Canal) with Hamburg. The combined waterway consisting of the Rhine-Herne Canal, the Dortmund-Ems Canal, the Ems-Weser Canal, and the Hansa Canal, will then constitute the shortest waterway connection between Duisburg-Ruhrort on the Rhine and

Hamburg (and beyond it to Kiel and Lübeck), the chief intermediate transhipment centres being Gelsenkirchen (for the Ruhr), Münster, Osnabrück, and Bremen.

The length of the Hansa Canal will be about 120 miles, and the distance by water between Hamburg and the Ruhr (Gelsenkirchen) about 240 miles. The plans provide for a width sufficient to admit 1,000-ton barges everywhere, and this width can be increased if it is found necessary. The Canal is to branch off from the Ems-Weser Canal north of Osnabrück, to cross the Weser above Bremen by means of a bridge (two connections being planned with the Weser itself), to cross the Alte Süderelbe near Moorburg, and to link up with the port of Hamburg direct. A separate branch is to connect with the Lower Elbe near Stade in order to provide vessels with a short route to Kiel *via* the Kiel Canal, whereas those bound for Lübeck will first proceed from Hamburg *via* the Upper Elbe and afterwards by way of the Elbe-Trave Canal.

The Hansa Canal project is undoubtedly one of the most valuable suggestions for improving the German system of waterways, and in view of the general interest the plans for its construction have aroused it is to be hoped that work on it will be started as soon as possible.

* * *

The Position of Hamburg in relation to he Continental Railway System.

It is but natural that the place where sea-borne traffic and river-borne traffic meet should also have developed into an important railway junction. Enormous though the quantities of cheap bulk goods of all kinds are that are transhipped to and from rivercraft in the port of Hamburg, the fact remains that thanks to the numerous consignments of high-class exports and imports passing through, Hamburg is still a port in which the latter kind of traffic preponderates, and it is the railroad that carries the major part of this merchandise. It has already been stated that the share of the railways in the movement of goods to and from Hamburg now actually surpasses that of the inland waterways — the percentage carried by them amounting to 55% of the total inland goods traffic, as against 38 to 40% in pre-war years.

This traffic is borne by six railroad lines converging upon Hamburg. Three of them join at Harburg south of the Elbe, proceeding to Hamburg *via* the Elbe bridges, whilst the remaining three, viz., those from the north and east, reach Hamburg separately. The three southern lines are: (1) the line from Harburg to the west *via* Bremen, (2) that from Harburg to the south *via* Ülzen and Hanover and to the south-east *via* Stendal and Magdeburg, and (3) that from Harburg to Cuxhaven. The last-named line is not very important in connection with the goods traffic to and from Hamburg, but is of great importance as a carrier of the overseas passenger traffic between Hamburg and her outport. The three northern lines are: (1) the line to Berlin and the eastern part of the hinterland *via* Wittenberge, (2) that from Hamburg to

Königsberg *via* Lübeck, Rostock, Stralsund, Stettin, and Danzig, by which Hamburg is linked up with the north-east of her hinterland, and (3) that to the north which divides into branches to Kiel *via* Neumünster, to Flensburg *via* Neumünster and Schleswig, and to Tondern *via* Elmshorn and Husum.

The goods traffic on these five principal lines is so considerable that Hamburg takes third place among all German cities in this respect. In 1924 her importance as a railroad centre was only surpassed by Berlin (plus 40%) and Mannheim (plus 3%). Her rail-borne traffic exceeded that of cities like Bremen, Leipzig, Duisburg and Munich by 150 to 200%, that of Dresden, Magdeburg, Frankfort-on-Main, and Hanover by 200 to 250%, and that of Breslau, Nuremberg, Stettin, and Stuttgart by 300 to 350%.

The following list shews the distribution of the rail-borne traffic handled in the Greater Hamburg area in 1924.

Mecklenburg, Lübeck, and Schleswig-Holstein	21.90%
Hanover, Oldenburg, and Brunswick	19.46%
Westphalia and the Ruhr	12.36%
Thuringia and Prussian province of Saxony	8.20%
Brandenburg, including Berlin	7.88%
Saxony (free state)	6.60%
Czecho-Slovakia	4.63%
Bavaria	3.71%
Silesia	2.33%
Hesse (free state and Prussian province)	2.03%
Poland	1.61%
Weser ports	1.48%
Württemberg	1.23%
Baden	1.19%
Austria	1.10%
Pomerania	0.97%
East Prussia	0.34%
Switzerland	0.27%
Denmark	0.26%
Hungary	0.17%
Eastern Marches (*Ostmark*)	0.11%
Italy	0.07%
Jugo-Slavia, Bulgaria, Greece, and Turkey	0.05%
Sweden and Norway	0.04%
France	0.03%
Danzig	0.03%
Luxemburg	0.02%
Roumania	0.02%
Belgium	0.01%

★

The Extent of the Hinterland.

An approximate idea of the extent of the hinterland served by the Port of Hamburg may be obtained from a study of the accompanying Map No. III which incorporates the particulars relative to the river-borne traffic and the rail-borne traffic already given in the lists on page 9 and immediately preceding this paragraph. Owing to the absence of statistical information it has not been possible to include that section of the rail-borne traffic which is concerned with the on-carrying of the goods after they have left the up-river barges, nor that handled by the lines acting as feeders to the latter. The map, therefore, does not shew the ultimate ramifications of the transportation system serving the hinterland of Hamburg.

★

The Sea-borne Traffic of the Port of Hamburg.

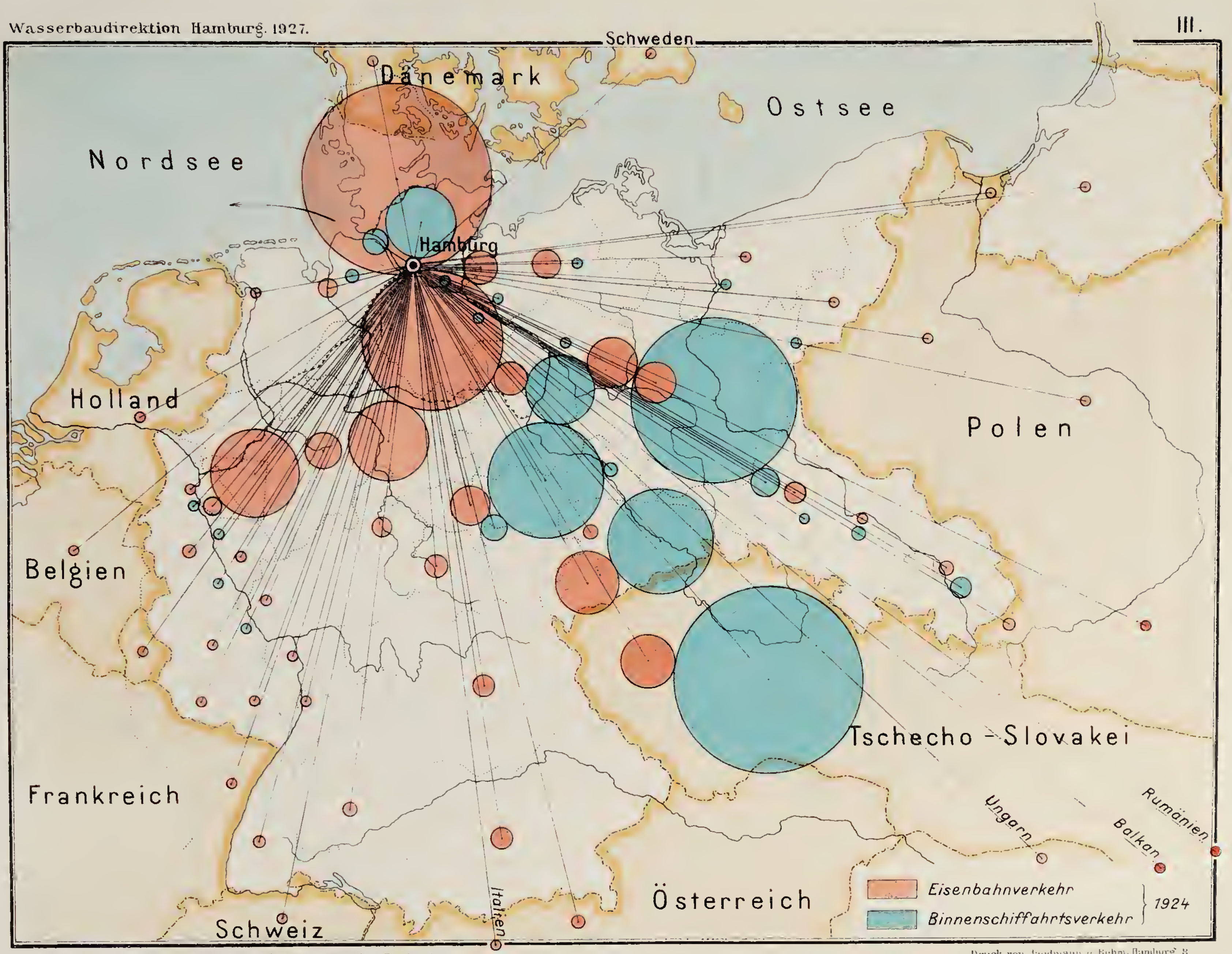
We shall now discontinue our description of the hinterland served by the Port of Hamburg and of the land and water connections between them, and revert to the subject of Hamburg's maritime traffic from which our appreciation of the international position of the great seaport started. The district linked up with Hamburg by means of waterways and railroad lines is only a part of the area whose overseas communications pass through her port. Large quantities of goods intended for exportation reach Hamburg by the sea route from other German ports and from the North European countries adjoining Germany. Regular weekly services are maintained by the shipping companies to collect such cargoes and to carry them to Hamburg. There they are transhipped to the overseas steamers, and similar work is performed in the reverse direction, i. e., in the on-carrying of imports from overseas countries to their final destinations. An important link in this European freight traffic to and from Hamburg is the Kiel Canal already referred to (cf. page 4). We must therefore bear in mind that, in addition to serving the needs of its immediate hinterland with the aid of its railroad and inland waterway connections, and quite apart from the needs of Greater Hamburg itself — which are by no means insignificant — the Port of Hamburg has to handle the considerable volume of through-freight cargo collected and distributed by it *via* the sea route.

If we base our comparison on the net register tonnage of the ships concerned, we find that the sea-borne traffic of Hamburg is about evenly divided between European and extra-European countries. The proportion was 51 : 49 in 1913, and 48 : 52 in 1924.

Reference Note to the accompanying Map No. III.: The Rail-borne and River-borne Cargo Traffic between Hamburg and her Hinterland in 1924. Red denotes rail-borne traffic, and blue denotes river-borne traffic, both on the basis of tons weight. The blue circles in the Rhine district refer to the combined sea-borne and river-borne traffic between Hamburg and the Rhine ports.

Wasserbaudirektion Hamburg. 1927.

III.



Bearbeitet im Kartographischen Bureau der Wasserbaudirektion Hamburg.

Druck von Jagdmann & Behm, Hamburg 8

The total sea-borne traffic of Hamburg (i. e., sailings and arrivals combined) is shewn by the following figures:

1913: 31,700 ships of 28.6 million net register tons
1924: 27,600 ,, ,, 31.3 ,, ,, ,, ,,
1926: 31,800 ,, ,, 35.1 ,, ,, ,, ,,

These figures indicate that the tonnage engaged in this traffic has increased by 23% since the year preceding the war, whereas the number of ships has remained about stationary. The average increase in the size — which, as far as it interests the port engineer, means in the draught — of the vessels is 20%, and the authorities responsible for the construction of new harbour basins since the close of the war have had to pay due regard to this important change.

The incoming sea-borne traffic from European ports 1925 (7.51 million net reg. tons) was distributed as follows:

United Kingdom	30.0%
German ports	21.6%
Netherlands	9.5%
Denmark	6.6%
Sweden	5.3%
Norway	4.6%
Belgium	4.4%
Spain and Portugal	4.0%
France	3.7%
Russia and ex-Russian Border States	2.4%
Roumania	2.0%
Italy	1.7%
Turkey and Greece	1.0%
Danzig and Memel Territory	0.9%
Finland	0.8%
Bulgaria	0.8%
Ukrainia	0.7%

The figures for the outgoing sea-borne traffic to European destinations did not essentially differ from the preceding ones.

The incoming sea-borne traffic from extra-European countries (9.13 million net reg. tons) was distributed as follows:

United States of America (Atlantic Coast)	23.0%
Argentine and Uruguay	13.8%
Japan, China, Russia in Asia	10.6%
British India	10.4%
West Coast of Africa	6.9%
East Coast of Africa and South Africa	4.9%

Canada and Newfoundland (Atlantic Coast)	4.6%
Dutch Indies	4.3%
Central America and West Indies	4.3%
South America (Pacific Coast)	3.9%
Brazil	3.9%
Australia	3.4%
Mediterranean and Black Sea Coast of Asia	2.7%
North America (Pacific Coast)	2.5%
Miscellaneous	0.8%

The outgoing sea-borne traffic to extra-European destinations (7.4 million net reg. tons) was distributed as follows:

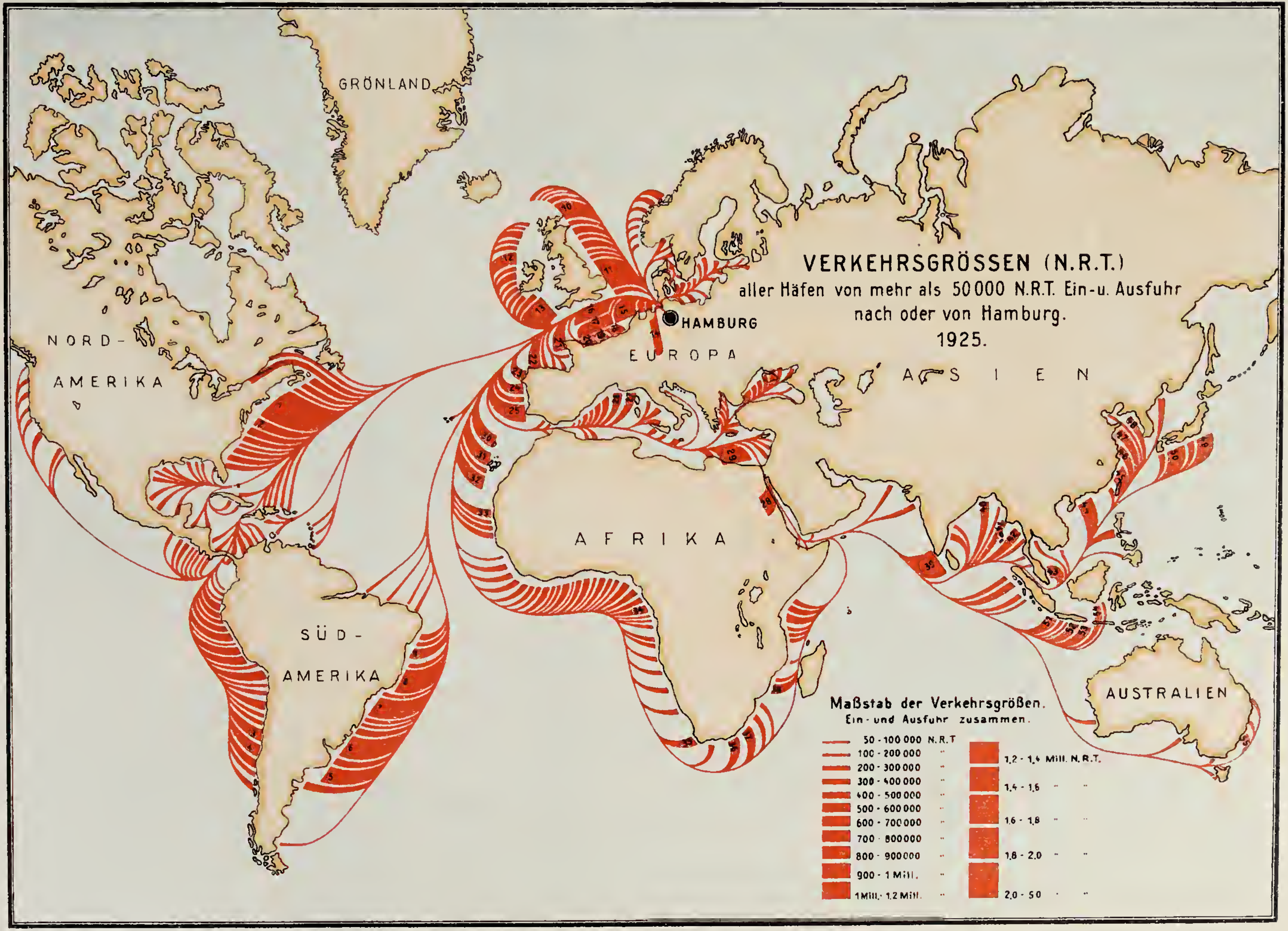
United States of America (Atlantic Coast)	24.7%
Argentine and Uruguay	13.8%
Japan, China, Russia in Asia	9.5%
British India	7.3%
East Coast of Africa and South Africa	6.6%
Brazil	6.4%
West Coast of Africa	5.8%
Central America and West Indies	5.3%
Australia	4.6%
South America (Pacific Coast)	4.2%
Canada and Newfoundland	3.5%
Dutch Indies	3.0%
Mediterranean and Black Sea Coast of Asia	2.3%
North America (Pacific Coast)	1.7%
Miscellaneous	1.3%

Map No. IV gives a general view of the ocean-borne traffic of Hamburg and also shews the relative positions of the chief foreign ports trading with her.

Reference Note to the accompanying Map No. IV.: The Overseas Goods Traffic of Hamburg in 1925. In this map all ports are included whose sea-borne traffic with Hamburg exceeds 50,000 net register tons *per annum*.

The width of the red strips is proportionate to the combined incoming and outgoing sea-borne traffic between Hamburg and the ports in question, and is graduated in accordance with the scale shewn on the map. In the case of ports whose sea-borne traffic with Hamburg exceeded 500,000 net reg. tons in 1925, small figures have been added. Reference as to the ports indicated by them should be made to the following list.

1. New York, 2. Philadelphia, 3. Antofagasta, 4. Valparaiso, 5. Buenos Aires, 6. Montevideo, 7. Santos, 8. Rio de Janeiro, 9. Bahia, 10. Newcastle-on-Tyne, 11. London, 12. Liverpool, 13. Southampton, 14. Bremen, 15. Amsterdam, 16. Rotterdam, 17. Antwerp, 18. Dunkirk, 19. Boulogne, 20. Le Havre, 21. Cherbourg, 22. La Coruna, 23. Vigo, 24. Leixoes, 25. Lisbon, 26. Marseilles, 27. Genoa, 28. Suez, 29. Port Said, 30. Funchal, 31. Teneriffe, 32. Las Palmas, 33. Dakar, 34. Lagos, 35. Cape Town, 36. Port Elizabeth, 37. East London, 38. Beira, 39. Colombo, 40. Calcutta, 41. Rangoon, 42. Penang, 43. Singapore, 44. Hongkong, 45. Shanghai, 46. Tsingtau, 47. Tientsin, 48. Dalny, 49. Yokohama, 50. Kobe, 51. Batavia, 52. Samarang, 53. Soerabaya, 54. Macassar, 55. Sidney.



VERKEHRSGRÖSSEN (N.R.T.)
aller Häfen von mehr als 50000 N.R.T. Ein-u. Ausfuhr
nach oder von Hamburg.
1925.

Bearbeitet im Kartographischen Bureau der Wasserbaudirektion Hamburg.

Druck von Jagdmann u. Bohm. Hamburg 8.

This map should be studied in conjunction with that shewing the hinterland (Map No. III).

By far the largest part of the sea-borne trade of Hamburg is carried by steamers engaged in regular services. The number of such services is 199, and the number of shipping companies maintaining them is 126. Forty-six of the latter are German and eighty of them are foreign concerns.

The share of the German flag in this traffic calculated on the basis of the net register tonnage of the vessels arriving and leaving *per annum* was 38.5% (1925). The percentages of foreign flags were as follows: United Kingdom 26.4%, Netherlands 11.2%, United States 4.0%, France 4.0%, Norway 4.0%, Japan 2.5%, Denmark 2.5%, Panama 1.3%, Sweden 1.3%, Italy 0.8%, Danzig 0.8%, Spain 0.5%, Greece 0.5%, Brazil 0.4%, Belgium 0.4%, Russia 0.3%, whilst twelve other countries shared in the remaining 0.6%.

The following figures indicate the amount of the merchandise arriving and leaving by the sea route.

Arrivals:	Year	Millions of Tons
	1913	16.5
	1924	13.0
	1926	11.0
Departures:		
	1913	8.9
	1924	6.5
	1926	10.9

For particulars concerning the movement of this merchandise traffic the reader is referred to the statistical appendix in Section VIII.

* * *

Some Additional Factors contributing to the Development of the Port of Hamburg.

The chief factors to which the development of the port of Hamburg as a centre of sea-borne, river-borne, and rail-borne traffic is due, have already been set forth in the preceding pages. All that remains to be done is to mention a few others that have contributed to this development. The hydrographical character of the Elbe is one of them. Hamburg lies on that part of the river which is subject to the rise and fall of the tides, but the difference between mean high water and mean low water in her port is only about six feet. It has therefore been unnecessary to provide the harbour basins with locks, so that Hamburg belongs to the class of always accessible seaports.

In the second place, the position of Hamburg as a free port and the fact that industry has settled in the free port area, have contributed to her rapid growth.

Lastly — and this is by no means the least important factor — her merchant firms, which for centuries have maintained close relations with all countries, together with her local shipping companies, have been of very considerable importance in regard to the development of the port in that they have attracted to it an enormous volume of international trade, thus enabling it to become the mighty organism of which the following sections are intended to present a rough description.

SECTION TWO.

General Description of the Harbour Plan.

General Topography of the City-State of Hamburg.

The Free City of Hamburg, one of the federal states that make up the German Republic, covers an area of about 160 square miles (cf. Map No. I). It comprises the four municipalities of Hamburg, Bergedorf, Geesthacht and Cuxhaven, as well as 28 rural communes. The share of the municipality of Hamburg in this total is about 52 ½ square miles, and that of the Ritzebüttel district — the detached portion near the mouth of the Elbe with the outport of Cuxhaven — about 30 square miles. The population of the whole state (June 16th, 1925) is 1,152,480, and that of the municipality of Hamburg alone 1,074,990.

The larger part of the Hamburg State territory is located on the right or northern bank of the River Elbe which, generally speaking, flows through it in the direction from east to west. This part is bounded by the Prussian province of Schleswig-Holstein. The Schleswig-Holstein towns of Wandsbek and Altona situated at the very doors of Hamburg (to the east and west respectively) belong to the same economic unit as the latter. The smaller portion of the Hamburg State territory, viz., that containing the greater part of the harbour, is on the left bank of the Elbe and is bounded by the Prussian province of Hanover. The Hanoverian town of Harburg-Wilhelmsburg is in close vicinity to Hamburg on that side.

If we disregard a few enclaves surrounded by Prussian territory (viz., Moorburg in the south, Geesthacht in the east, Farmsen, Volksdorf, Wohldorf and Gross-Hansdorf in the north), we may say that the Hamburg State territory is made up of three sections radiating from the neighbourhood of the Elbe bridges and extending to the north, west, and south-east respectively. These three sections may be roughly characterised as *(a)* the municipal section, extending northward for about 10 miles, having a width of 1¼ to 6¼ miles, and lying on both sides of the River Alster; *(b)* the rural section, extending south-east for about 14 miles in the direction of the Upper Elbe, having a width varying from 4½ to 6¼ miles, and including the town of Bergedorf; and *(c)* the harbour section, extending westward on the left bank of the Lower Elbe for about 9½ miles and ranging in width from 1 to 2 miles.

A configuration such as this, although it may appear somewhat irregular to us, is nevertheless the outcome of a carefully thought-out territorial policy, and it must be remembered that the ancient Hanseatic city on the Elbe became aware of her economic destiny at a very early period. Hamburg could never have attained to her commanding position as a seaport of international importance if she had failed to secure in good time the strip of territory situated on the left bank of the Elbe. If, in spite of her forethought, the configuration of her territory did not prove so helpful to her in solving her economic tasks as did her geographical situation at the junction of important traffic arteries, the reason is that her territorial boundaries which, in earlier days, were fluctuating a great deal, had become much more rigid by the time she began to develop into an economic centre. The play of accident in the delineation of her boundaries together with certain topographical peculiarities of the site have made it incumbent upon her to apply the utmost circumspection in utilising to best advantage the area available for the construction of her harbours. The subjoined description of the harbour area is intended to shew how she overcame the difficulties that confronted her — difficulties that continued to increase in proportion as her trade expanded.

★

Topography of the Harbour Area.

The topographical conditions of the area on the northern bank of the Elbe, i. e., the municipal section of the State area, do not favour the construction of harbour facilities on that side. Centuries ago a large number of small low-lying islands occupied most of the district between Hamburg and Harburg. Their size and shape constantly altered, because they were subject to the effects of the tide. In course of time most of the waterways between them were dammed up, so that their number became less and less, and only a few of the larger ones retained their separate identity. Dykes were built to protect them from the inundations of the river, and the land could then be used for farming. The alluvial soil *(Marsch)* of which it consists is exceedingly fertile. The older diluvial formations *(Geest)* extend to the north and south of the former archipelago, but whereas the southern diluvial ridge, near Harburg, is at a considerable distance from the principal river, the northern ridge is comparatively near and forms a fairly steep gradient towards it.

The municipal section of the State territory contains but a narrow strip (just over half-a-mile wide) of alluvial soil near the mouth of the River Alster, and this explains why no harbour basins, except those on Grosser Grasbrook and Baakenwärder, could be constructed on the northern bank of the Elbe. Further east the northern diluvial ridge recedes beyond the River Bille, a tributary of the Elbe which rises in the Sachsenwald and forms the northern boundary of the rural section above referred to. That section consists entirely of alluvial soil and comprises the districts of Billwärder, Billbrook, and Vierlande. In the up-river direction, however, there is not much space for the expansion of the Port of Hamburg, because the nature of the river makes it impossible to provide the necessary depth. Moreover, the exigencies of land traffic demanded the construction of bridges across the Elbe, and once these had been built, the upper limit of the port was irrevocably fixed. This means that no sea-going vessels can proceed beyond the Elbe bridges. The up-river districts adjacent to the harbour area (i. e., Billwärder, Moorfleth and Billbrook on the right, and Veddel and Peute on the left bank) are utilised for the purposes of river navigation and industry. The remainder of the alluvial district still further east, which is accessible to rivercraft by the Dove Elbe and Gose Elbe — two former branches of the main river — forms an exceedingly fertile fruit and vegetable producing district.

Near and below the mouth of the Alster — where the original harbour was situated — the strip of alluvial soil between the river and the northern diluvial ridge that can be used for shipping purposes is exceedingly narrow. The construction of modern harbour basins in that part is out of the question. For the same reason Altona, the city adjoining Hamburg in the west, has always had the greatest difficulties in constructing any harbour works at all.

If thus the topographical conditions of the northern bank of the Elbe have not proved very helpful to the needs of shipping, conditions are different on the southern bank where the low alluvial land could be used at will. Development, however, had to stop at the Prussian boundary. On the whole, the boundary line runs parallel to the river, but in a slightly zigzag way. This section of her territory, so enormously important for the growth of her port, was acquired by Hamburg in 1768 through the Treaty of Gottorp. Since that date the boundary has only been altered once, viz., by the Third Köhlbrand Agreement concluded with Prussia in 1908, which provided for a slight rectification of the inter-state boundary advantageous to the Port of Hamburg. Opposite Altona and the Elbe suburbs adjacent to it the fairway of the river constitutes the boundary of the State. From all this it follows that the area where Hamburg has full control of both banks of the river is limited to the small section between the Elbe bridges and the Altona boundary (i. e., about three miles).

The foregoing account shews how narrow are the confines within which Hamburg has had to construct and develop her port.

★

The Intersection of the Harbour Area by Water Courses.

The division of the area just described into smaller units is brought about (1) by the Elbe and its branches, and (2) by the main railway line approaching Hamburg from the south.

About 6 ¼ miles above Hamburg, near Bunthaus, the Upper Elbe separates into two main channels, i. e., the Northern Elbe *(Norderelbe)* on which Hamburg is situated and which forms part of the Hamburg harbour, and the Southern Elbe *(Süderelbe)* which flows past the Prussian city of Harburg. Both channels receive equal quantities of water, the adjustment being effected by the river regulation works at Bunthäuser Spitze. The Southern Elbe, called Köhlbrand in its lower reach where it flows through Hamburg territory, rejoins the Northern Elbe opposite Altona, and from that point to the sea the united river is called Lower Elbe *(Unterelbe)*. The Köhlbrand channel cuts right across the left-bank harbour area, and forms at the same time the waterway by which sea-going ships can reach Harburg. Since the completion of the Köhlbrand improvement schemes the former continuation of the Southern Elbe to its junction with the main river, called Alte Süderelbe, has lost its importance. This latter branch, the main river, and the Köhlbrand enclose between them the island territory of Altenwärder, Finkenwärder, and Waltershof. There is also a minor branch, the Köhlfleth, which separates some of the small islands from one another. A dam has been built right across it under the terms of the 1908 Köhlbrand Agreement (cf. below), which also provides for a similar dam across the Alte Süderelbe. Waltershof and the Hamburg portion of Finkenwärder form the area still available for the future expansion of the Port of Hamburg. Altenwärder, however, which lies between the Hamburg districts of Moorburg and Waltershof, belongs to Prussia.

The island enclosed by the Northern and Southern Elbe measures about 5 miles from east to west and about $4^1/_2$ miles from north to south. The extent to which it has been developed varies enormously in its different sections. This is due to the fact that the boundary line between Hamburg and Prussia cuts right across it. Its northern (Hamburg) section — every square yard of which is turned to useful account — comprises the main part of the Port of Hamburg. The names of the various districts, viz., Peute (above the Elbe-bridges), Veddel (flanking the railway line on either side), Kleiner Grasbrook (the eastern shore of the Reiherstieg), Steinwärder (the western shore of the same), Kuhwärder (near the mouth of the Köhlbrand), and Ross-Neuhof (higher up the Köhlbrand), are reminiscent of the time when these parts were exclusively used for farming purposes.

The greater portion of the island belongs to Prussia. It is called Wilhelmsburg and forms part of the municipality of Harburg-Wilhelmsburg. It contains a number of industrial concerns (some of which are of considerable importance), a few harbour installations, and some scattered residential quarters, and has also provided the site for the Wilhelmsburg Shunting Station (*Verschiebebahnhof Wilhelmsburg)* of the National Railway Company, which regulates, for the present at least, the major part of railway traffic to and from the Port of Hamburg. Some large marginal sections of the island have not so far been developed industrially.

Between the Shunting Station and the Southern Elbe the Reiherstieg channel completely intersects the island area in the direction from south to north. One of its branches, the Reethe, is now being developed for harbour purposes. In its Prussian section the Reiherstieg is mainly used as the carrier of some local traffic, and even that traffic is by no means brisk. Its Hamburg reach, on the other hand, is of great importance. It has been made deep enough to accommodate sea-going vessels, and both of its banks are closely lined with industrial concerns and warehouses.

The municipal districts on the right bank of the Elbe co-terminous with the harbour and possessing quay equipment for the purposes of shipping are: (1) St. Pauli, situated near the western boundary opposite Steinwärder and adjoining Altona. There we find the fish market, the St. Pauli Landing Stages, and the Elbe tunnel. (2) and (3) Neustadt and Altstadt. These two districts together constitute the original "city" of Hamburg and contain the site of the original harbour. They are separated from St. Pauli by a belt of public gardens laid out on the site of the demolished fortifications. The Neustadt (new city) extends as far as the mouth of the Alster where this tributary enters Binnenhafen. The greater part of its water frontage faces the main Elbe, and there are quays and other facilities for shipping. The Altstadt (old city) extends in an easterly direction as far as the two-storied railway bridge across Oberhafen. It is separated from the main Elbe by the Grosser Grasbrook district which contains numerous warehouses and harbour installations, and is indirectly connected with it by way of the belt canal along the northern edge of the harbour that links up the Lower Elbe with the Upper Elbe without passing through the free port area. Above the railway bridge just mentioned this canal widens considerably and there skirts the municipal districts of (4) Hammerbrook, (5) Billwärder-Ausschlag, and (6) Rothenburgsort, where equipment is provided for the needs of up-river traffic, especially for those of the steamer connections with the hinterland of the port. The total water frontage of the municipality of Hamburg from the Altona boundary to Tiefstaak Canal has a length of about five miles.

The right-bank tributaries of the Elbe within the Hamburg territory, viz., the Alster, Bille, Dove Elbe, and Gose Elbe, are not of very great importance in connection with the harbour, except in that they are the means by which a fairly brisk local traffic is maintained between it and the industrial and agricultural establishments along their courses. Alster and Bille are provided with lock entrances and link up with the belt canal already referred to. The Dove Elbe joins the main stream above the harbour area and has not, like the Gose Elbe, a lock entrance. More than four hundred years ago the upper ends of both these waterways were banked up by dykes and thereby separated from the Elbe itself.

★

The Intersection of the Harbour Area by the Railway Line and the Bridges.

It has already been pointed out that, in addition to the natural and topographical conditions of the harbour area, the railway line intersecting it has affected the development of the Port of Hamburg in several important respects. The Northern Elbe had to be bridged because it became necessary, firstly, to connect the city proper and the harbour basins on the right bank of the Elbe with the national railroad system south of the river, and secondly, to join together the two parts of the harbour area. Once, therefore, the construction of a bridge was resolved upon, the up-river limit of ocean-borne traffic had to be likewise definitely fixed. The problem became acute about the middle of the past century. At that time the only railway connection possessed by Hamburg was the line to Berlin, but it was decided to provide a similar link between the Elbe port and the western part of its hinterland. The authorities fully realised that the choice of the place where the new line was to cross the Elbe would decisively affect the future development of the entire economic area. Three years (from 1854 to 1857) were spent in trying to reconcile the conflicting views concerning the river, the rate policy of the railroads, and the general interests of the latter with the claims of shipping — claims, however, which not could be precisely formulated until at a much later period. A distance of about 4½ miles separated the two extreme points that had to be considered on their respective merits. Finally, after protacted negotiations, a bridge was built (1868/1872) about two miles above the mouth of the Alster, and thus the up-stream limit of sea-borne traffic was definitely fixed. Subsequently it was often suggested that the area thus delimited was too small for the needs of ocean-going shipping, and that the bridges — their number having meanwhile been increased to two — should be pulled down and rebuilt higher up the river, but these suggestions have never been acted upon. Indeed, the completion (in the spring of 1926) of a third bridge has confirmed for all times the decision originally arrived at. The second bridge — which serves the needs of vehicular traffic — was built about 220 yards higher up the river than the first, whereas the third was built just below it.

★

The Map of the Port of Hamburg.

In the preceding chapters it has been pointed out that a profound influence was brought to bear upon the ultimate configuration of the harbour area by a great variety of factors, viz., the condition of the Elbe and its branches, the site of the city, the position of the diluvial ridge on the right and the course of the Hamburg state boundary on the left bank, the bridges across the river, and the intersection of the whole area by the railway line. The accompanying map is intended to illustrate what has been said so far.

The map[1] is drawn to the scale of 1 : 25,000, that is, about two-fifth of a mile to an inch. The most easterly portion shewn on it is the district near the Billwärder-Moorfleth industrial canal and the mouth of the Dove Elbe. The lock entrance to Müggenburger Kanal on the left bank near the place where the State boundary crosses the river may be looked upon as the upper limit of the Port of Hamburg, using the term in its narrowest sense. A little higher, viz., at the spot marked 615 (615 kilometres, or 382¼ miles, from the German-Czechoslovak frontier), there is the junction of the Dove Elbe with the main river. The most westerly detail shewn on the map is the Deutsche Werft shipbuilding yard, the farthest situated establishment down the river within the area of the port. The extent of the Port of Hamburg between the two extreme points mentioned, as measured along the fairway of the river, is 9½ miles. The State boundary, however, extends another 3 miles down the river, so that Hamburg will have at her disposal a water frontage of 12½ miles on the southern bank of the Elbe once the necessary improvements have been made.

---

[1] *It must be borne in mind that the design of the map conforms to the method usually adopted in river charts, so that the Elbe is shewn as flowing from left to right. Thus, the arrow indicating north points towards the lower margin of the map. The territory belonging to Hamburg is coloured red, that belonging to Prussia green, and the Hamburg state boundary yellow. The Free Port area is marked by a dark, and the Customs Union area by a light shade of colour.*

In the description of the general topography of Hamburg it has already been pointed out that the facilities for harbour development on the right bank of the river are very considerably restricted. Local conditions being what they are, no real harbour works can be constructed above the Elbe bridges, so that the water frontage available for such purpose on that side covers little more than three miles, i. e., the distance between the Elbe bridges and the boundary of Altona.

The approximate southern limit of the map area is denoted by the junction of the Köhlbrand and the Köhlfleth, whilst its approximate northern limit is Lombardsbrücke, the bridge separating the square basin of the Binnenalster from the Aussenalster. Thus, the older portions of the city have been included in the map, thereby increasing its usefulness.

★

General Design of the Harbour.

The first impression resulting from a cursory glance at the map is that the harbour installations are completely accommodated within a narrow, though compact, area whose length is not out of all proportion to its width. The lines of communication between the harbour and the city, as well as those between the various sections of the former, are as short as they can possibly be in a port of international importance. No part of the harbour is at a greater distance from St. Pauli Landing Stages than just over three miles by the water route, and any point along the extreme circumference may be reached from there in twenty or twenty-five minutes, but in spite of this compactness of design there is sufficient room for the unrestricted development of every single concern domiciled in or connected with the harbour.

★

The Principle of Harbour Basins cut into the Land.

A second characteristic of the Port of Hamburg is that the loading and discharging berths of the ships are not located alongside of piers projecting far out into the river, but within basins or slips cut into the land. In this respect Hamburg resembles all other ports situated a long way distant from the open sea. The reason why basins had to be cut into the land is that the river is not wide enough to permit an alternative system being adopted. Although the Elbe, between the eastern and western extremities of the port, widens from 738 to 1,870 feet, this width is only just sufficient to provide a safe avenue for the very considerable volume of traffic and enough room for the berths and floating docks on shore. Hence it was necessary to cut slips or basins into the land, and as these, on account of the tides, had to be made very deep, an enormous amount of dredging work was required.

★

The Principle of Open-Basin Harbours.

Another feature very typical of the Port of Hamburg is that access to the harbour basins is in no case rendered difficult by the provision of locks. Hamburg, in fact, has adopted the open-basin type of harbour. Under normal conditions of wind and weather the level of the water, owing to the effects of the tide (which are noticeable far beyond Hamburg), varies twice daily to the extent of 6 ft 6 ins, although the maximum difference between the highest and lowest level so far recorded is about 23 ft. Similar conditions have caused other seaports to adopt the system of closed dock harbours provided with locks either for single basins or for groups of them. Single locks of the usual type, however, are impractical in that they limit the movements of ships to and from their loading and discharging berths to a few hours every day, whereas the much more expensive chamber locks are liable to the objection that considerable delays and charges are incurred each time a vessel enters or leaves the dock. The effect in both cases is extremely detrimental to the speedy dispatch of vessels.

The principle of open-basin harbours has not always been universally acknowledged in Hamburg. A glance at the history of the port shews that, in connection with harbour and town-planning schemes of far-reaching importance, the competent authorities spent almost seventy years in trying to find a satisfactory solution of the difficult problem that faced them. The municipal archives contain a large number of dock harbour projects drawn up by leading experts from various countries. It was Johannes Dalmann, a director of the Board of Hydraulic Engineering, who gave his casting vote in favour of the open-basin harbour system, and who, by so doing, secured for himself a prominent place in the history of the Port of Hamburg. The paralysing effect of locks upon the quick dispatch of vessels is nowhere more pronounced than in a port where, as is the case in Hamburg, ocean-borne shipping and river navigation join hands and where most of the local harbour traffic also uses the water route. The Port of Hamburg could never have satisfied modern requirements if the unfettered movement of the hundreds of sea-going vessels, small steamers, barges, lighters, tugboats, and launches that cross it daily in every direction were made illusory by waits at the lock gates and within the locks.

The provision of unrestricted access, at all times of day, to any part of the harbour, is a very great advantage, and is appreciated by vessels of every description.

★

General Features of the Harbour Basins.

Another great advantage resulting from the absence of locks is that those responsible for the development of the Port of Hamburg were at liberty to design the basins and to utilise the available space without being hampered by any irrelevant considerations. It enabled them to construct the basins in such a manner that incoming vessels and the incoming tide can approach them at the most convenient angle. It is essential that vessels, upon entering a harbour basin, should have to deviate as little as possible from the course maintained during their passage up the river, and that the tide should be permitted to enter and leave the basins without giving rise to any currents that might detrimentally affect the navigation of ships or the condition of the river bed. These requirements can only be said to have been complied with if the angle contained by the river and the longitudinal axis of the harbour basins is as acute as possible. Hence, the various basins are arranged more or less on the same plan, those on the right bank extending approximately in the direction from east to west and those on the left bank from south-east to north-west. Wherever a different arrangement has been preferred, it was done for some special reason connected with the locality.

The entrance to each harbour basin is located at the downstream end, i. e., it faces the incoming vessels. The older type of basins admit them from the river direct. The vessels, assisted by tugs, have to turn round in midstream, and as the river is sufficiently wide for this purpose, they have no difficulty in doing so. The later type of basins are intended to accommodate large and very large vessels. They possess spacious outer basins communicating directly with the Elbe and affording the mammoth liners better facilities for turning round than they would have in the river itself. Masters, pilots, and others all agree that navigation in the Port of Hamburg is particularly easy, and it is a fact that accidents to ships have been very rare exceptions.

★

Loading and Discharging Facilietis.

The peninsulas that have been left jutting out between the various harbour basins are provided with facilities required for loading and discharging seagoing vessels and for handling inward and outward-bound cargoes. The methods employed for these purposes are very much the same whatever the nature of the goods, so that the quay equipment in use is characterised by a general uniformity of type.

The piers projecting out into the water are used for identical purposes on both sides. They accommodate two rows of quay sheds symmetrically arranged and containing such accessory equipment as lifting gear, loading approaches, railway tracks, etc. A wide road separates the two rows of sheds. The width of the piers is determined by that of the sheds which, in its turn, depends on the measurements of the vessels despatched (Fig. 2). Since, however, the chief measurement concerned is the draught of the vessels, it is obvious that the width of the sheds is to a large extent proportionate to the depth of the basins.

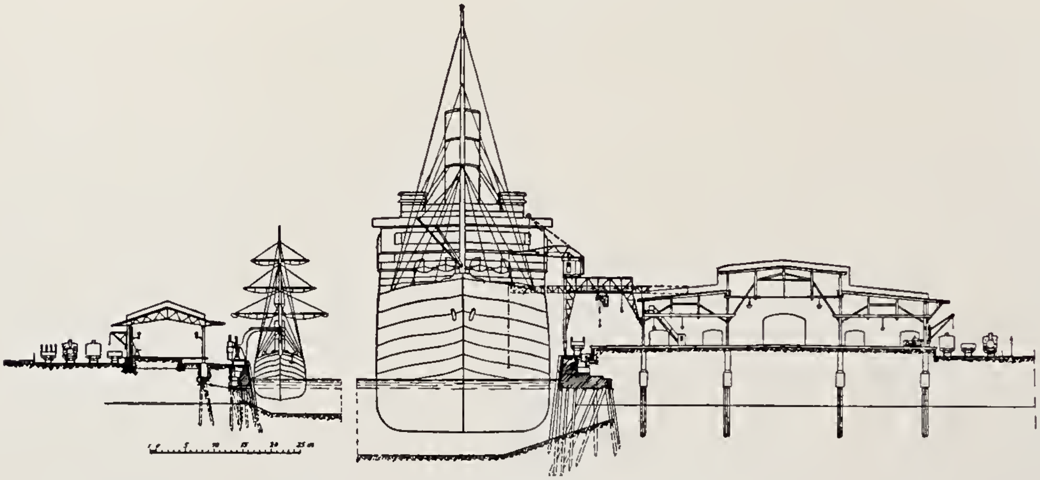


Fig. 2. Development of the Quay Shed.

The subjoined table shews some of the principal items just referred to.

Group of Harbour Basins	Width of Sheds in feet	Depth of Water in feet below M. H. W.	Average Size of Ships in tons gross
Grosser Grasbrook ...	50—80	24—25	150— 2,500
Baakenwärder-Veddel	70—140	30	800—14,000
Kleiner Grasbrook-Kuhwärder	160—165	30—32	6,000—20,000
Ross-Neuhof-Waltershof	160—165	36	For vessels of largest type

The width of the basins, on the other hand, is not solely dependent on the pier installations. Those of recent origin, indeed, are far more spacious than the greater size of the vessels despatched from their piers alone would necessitate. Whilst the widths of the three chief basins on the right bank of the Elbe range between 250 and 400 feet, the width of those now in course of construction is up to 1,000 feet.

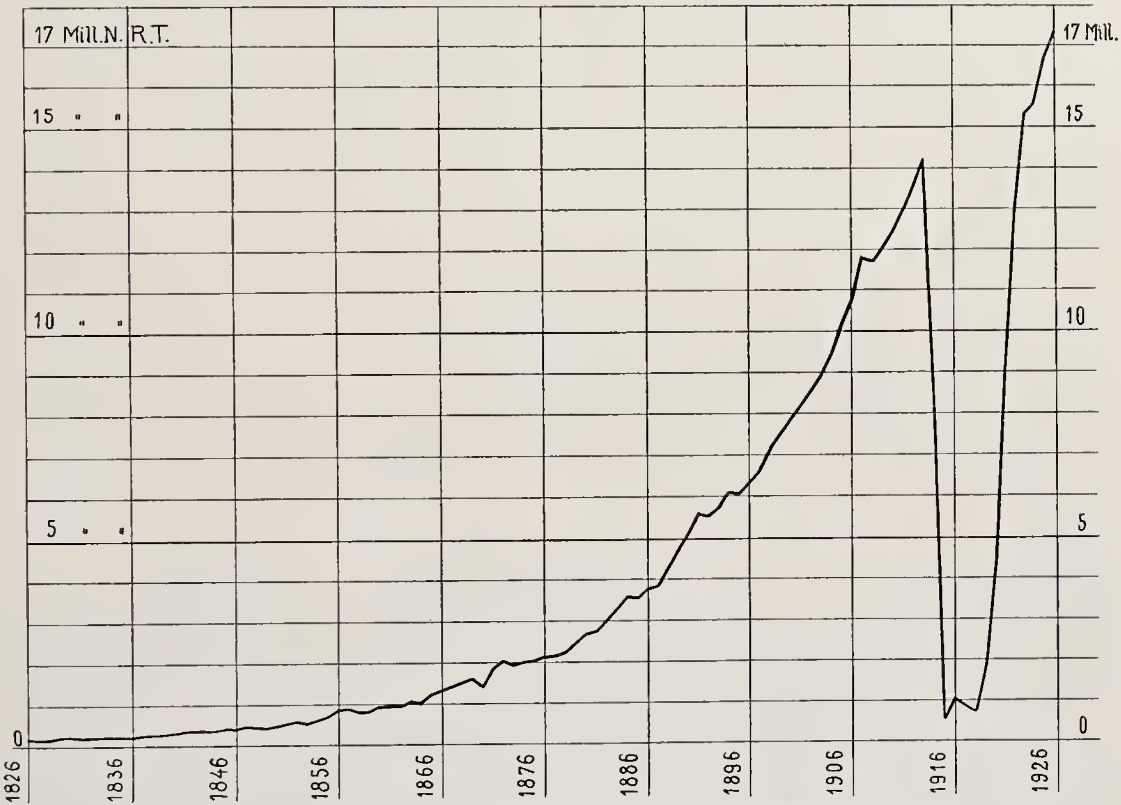


Fig. 3. Development of Hamburgs Sea-borne Traffic (1826/1926).

This increase is due to the development of the traffic in bulk goods. The accompanying diagram (Fig. 3) shews the remarkably sudden rise in the traffic figures for the port since the eighties of the past century — a rise mainly brought about by the growing ascendancy of bulk goods over other cargoes. It was this development that gave the Port of Hamburg its really international character, transforming it from one principally catering for the needs of its own hinterland into one serving the requirements of numerous different countries, and it was not until the period referred to that quantities of goods in excess of the needs of its hinterland began to accumulate in its sheds and warehouses. In the historical section of the present volume it will be shewn that the whole of this development was closely connected with the entry of Hamburg into the German Customs Union then under contemplation.

The connection between the increased traffic in bulk goods and the increased measurements of the new harbour basins is that, generally speaking, the technical equipment required for handling such cargoes is altogether different from that required for handling package freight — the type of cargo largely preponderating in the preceding era. There is, of course, no hard-and-fast definition of the term "bulk goods". Certain articles, e. g., coal, ore, timber, mineral earths, building stone, cement, salt, and artificial manure, are practically always carried as bulk goods, but there are certain others usually packed in sacks or bales that lose their character of package freight when they are carried in very large quantities and, from a commercial point of view, they are homogeneous in kind. To a certain extent large shipments of bulk goods indicate that trade is good, because it is only in times of economic stability that big quantities — and indeed, even whole shiploads — of such goods can be put on the market.

Bulk goods, from the point of view of pier operation, differ from all others in that there is no need to sort them according to quality. Such sorting, however, is one of the principal operations performed on the piers, and as, of course, it is altogether superfluous for goods not requiring it to be temporarily stored in the pier sheds, such storage — being rather expensive — is eliminated whenever possible. The goods concerned are transhipped direct from the sea-going vessel into river boats or other craft, such transhipment taking place in midwater and not alongside the piers or embankments (Fig. 60). In the Port of Hamburg — where the distribution of goods within the harbour and the connection between sea-borne and up-river traffic is largely effected by small (open or covered) barges of 10 to 250 tons burden — this method of transhipment plays a very prominent part. It is spoken of as midstream transhipment as distinguished from transhipment on the quay. The term "midstream" must no be taken in its strictly literal sense, because it is not meant to imply that transhipment takes place exclusively in the open river. Such was, indeed, the rule prior to 1866 — the year when the first pier was completed, and even now certain parts of the main river near its right (cityward) bank are separated from the fairway and reserved for such purposes, but the area thus reserved has long ceased to be sufficient. Therefore the open spaces of the harbour basins have to be used for "midstream" transhipment as well, and it has become the general practice for vessels discharging most of their cargoes at the piers to transfer part of them to small rivercraft lying along their waterside (Fig. 65, 75). This circumstance, in fact, explains why the basins built since 1880 or thereabouts are very much wider than the long and narrow ones of earlier origin which approach the true type of railway docks. The intimate connection between sea-borne and up-river traffic and the relative importance of the quantities of piece goods and bulk goods handled — factors which, as has been said, are typical for the Port of Hamburg — are recognisable in the design of the more recent constructions only.

In each of these comparatively wide basins one or more rows of dolphins have been rammed into the bottom soil. Their local name is *Dückdalben,* a word which is probably of Low German origin. The vessels are either moored to them direct, or are kept at a certain distance by means of strong booms. The object of booming-off is to enable the lighters to take up positions both at the starboard and at the port sides of the vessels, so that work may proceed at both sides simultaneously. It frequently happens that vessels berthed in "midstream" have to avail themselves of floating steam winches ("donkeys"), floating cranes, or elevators in addition to their own loading tackle, so that they must make the best possible use of the available water space. When, therefore, designs for the construction of additional harbour basins with one row of dolphins down the middle and one more in front of each of the two opposite banks are prepared, provision is always made for a width of 1,000 feet.

Quay or pier walls, of course, are only required in those basins where quay operations actually take place. Where the transhipment of cargoes is effected in "midstream", they are not needed, and there the sides of the piers are made to slope.

Harbour basins to which the foregoing particulars apply always represent a transitional stage of development. What usually happens is that a new basin is at first used solely for "midstream" transhipment and that its banks are made to slope, but that subsequently, when a demand for pier facilities arises, proper quay walls are constructed in place of the sloping embankments. A typical instance of a basin in the transitional stage is Waltershofer Hafen, a cross section of which is shown in Fig. 4. It well illustrates conditions in a basin intended for "midstream" transhipment.

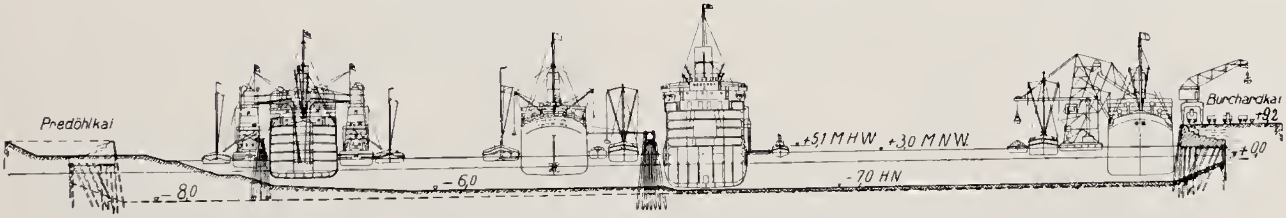


Fig. 4. Sectional Diagram of Waltershofer Hafen.

★

The Basins for Sea-going Vessels.

The following summary contains some particulars concerning the nineteen basins for sea-going vessels and the four similar areas separated from the fairway of the main river by rows of dolphins which, for the sake of brevity, may be described as "open-river harbours". The details given are: *(a)* Date of opening. *(b)* Area of water space. *(c)* Width of basin. *(d)* Depth of water below M. H. W. *(e)* Length of rows of dolphins. *(f)* Names of piers with their lengths in feet. *(g)* Names or numbers of quay sheds erected on them.

A. On the Right Bank.

I. Neustadt, off Johannisbollwerk.

(1) Nieder-Hafen (an "open-river harbour").	(*a*) About the middle of the XVIIth century.
(*b*) 22 acres.	(*c*) 330 feet.
(*d*) 26 feet.	(*e*) 3,600 feet.
(*f*) Johannisbollwerk (1,000 feet).	(*g*) Two pier sheds without special names.

II. Grosser Grasbrook.

(2) Sandthor-Hafen.	(*a*) 1866.
(*b*) 24 acres.	(*c*) 260 to 360 feet.
(*d*) 26 feet.	(*e*) No dolphins.
(*f*) Sandthorquai (3,300 feet).	(*g*) Sheds Nos. 1 to 7.
Kaiserquai (2,900 feet).	Sheds Nos. 8 to 12.
(3) Schiffbauerhafen (an "openriver harbour").	(*a*) 1882.
(*b*) 3 acres.	(*c*) 200 feet.
(*d*) 26 feet.	(*e*) 920 feet.
(*f*) No special name.	(*g*) Kaiserspeicher.
(4) Grasbrook-Hafen.	(*a*) 1872.
(*b*) 16 acres.	(*c*) 250 to 475 feet.
(*d*) 24 feet.	(*e*) No dolphins.
(*f*) Dalmannquai (2,200 feet).	(*g*) Sheds Nos. 13 to 15.
Hübenerquai (2,000 feet).	Sheds Nos. 16 to 18.
(5) Strandhafen (an "open-river" harbour).	(*a*) 1879.
(*b*) 8 acres.	(*c*) 190 feet.
(*d*) 25 feet.	(*e*) 3,850 feet.
(*f*) Strandquai (1,840 feet).	(*g*) Sheds Nos. 19 to 21.
(6) Magdeburger Hafen (accessible to sea-going vessels as far as the Swing Bridge only).	(*a*) 1888.
(*b*) 4 acres.	(*c*) 285 feet.
(*d*) 30 feet.	(*e*) No dolphins.
(*f*) West bank (No special name, 690 feet).	(*g*) Fruit Shed "C".
East bank (Magdeburger Quai, 330 feet).	Fruit Shed "A".

III. Baakenwärder.

(7) Baaken-Hafen.
(*b*) 44 acres.
(*d*) 30 feet.
(*f*) Versmannquai (4,500 feet).
Petersenquai (4,100 feet).

(*a*) 1887.
(*c*) 400 to 460 feet.
(*e*) 3,000 feet.
(*g*) Fruit Sheds "A", "B", 22, and 23, Sheds Nos. 24 and 25.
Sheds Nos. 26 to 29.

(8) Kirchenpauer-Hafen (an "open-river harbour").
(*b*) 20 acres.
(*d*) 27 feet.
(*f*) Kirchenpauerquai (3,750 feet).

(*a*) 1891.
(*c*) 260 feet.
(*e*) 6,400 feet.
(*g*) Sheds Nos. 30 to 33.

B. On the Left Bank.

IV. Veddel.

(9) Segelschiffhafen.
(*b*) 85 acres.
(*d*) 30 feet.
(*f*) Asiaquai (4,000 feet).
Segelschiffquai (770 feet).
Amerikaquai (4,900 feet).

(*a*) 1888.
(*c*) 525 to 1,000 feet.
(*e*) 12,800 feet.
(*g*) Sheds Nos. 34 to 37.
Shed No. 48.
Sheds Nos. 38 to 42.

(10) Hansahafen.
(*b*) 87 acres.
(*d*) 30 feet.
(*f*) O'Swaldquai (5,300 feet).
Bremer Quai (1,900 feet).

(*a*) 1893.
(*c*) 400 to 1,300 feet.
(*e*) 10,800 feet.
(*g*) Sheds Nos. 43 to 47.
Sheds Nos. 50 and 51.

(11) Indiahafen.
(*b*) 27 acres.
(*d*) 30 feet.
(*f*) Australiaquai (2,150 feet).
Indiaquai (425 feet).
Afrikaquai (3,100 feet).

(*a*) 1893.
(*c*) 400 to 500 feet.
(*e*) 2,600 feet.
(*g*) Sheds Nos. 52 and 53.
Sheds Nos. 56 and 57.

V. Kleiner Grasbrook.

(12) Südwest-Hafen.
(*b*) 28 acres.
(*d*) 30 feet.
(*f*) Togoquai (not yet completely equipped).
Kamerunquai (3,000 feet).

(*a*) 1876.
(*c*) 330 to 725 feet.
(*e*) 3,450 feet.
(*g*) Sheds Nos. 60 to 62.

(13) Grenzcanal.	(*a*) 1909.
(*b*) 18 acres.	(*c*) 260 to 330 feet.
(*d*) 27 feet (near west bank only).	(*e*) No dolphins.
(*f*) Banks not specially named.	(*g*) Sheds Nos. 54 and 59.
VI. Kuhwärder.	
(14) Kuhwärderhafen.	(*a*) 1902.
(*b*) 58 acres.	(*c*) 660 to 750 feet.
(*d*) 30 to 40 feet.	(*e*) 3,100 feet.
(*f*) Steinwärder-Ufer (3,550 feet). Grevenhof-Ufer (3,300 feet).	(*g*) Used for shipyard purposes. Sheds Nos. 69 and 70, and sheds and warehouses ,,A" to ,,G" of the Lager- und Speditionsgesellschaft.
Mittelufer (410 feet).	Grain warehouse.
(15) Kaiser-Wilhelm-Hafen.	(*a*) 1903.
(*b*) 57 acres.	(*c*) 660 feet.
(*d*) 32 feet.	(*e*) 4,600 feet.
(*f*) Auguste-Viktoria-Quai (3,600 feet). Reiherquai (600 feet).	(*g*) Sheds Nos. 71 to 73.
Kronprinzquai (3,000 feet).	Sheds Nos. 74 and 75.
(16) Ellerholzhafen.	(*a*) 1903.
(*b*) 69 acres.	(*c*) 590 feet.
(*d*) 32 feet.	(*e*) 3,400 feet.
(*f*) Mönckebergquai (3,000 feet).	(*g*) Sheds Nos. 76 and 77.
(17) Kohlenschiffhafen.	
(*a*) 1913.	(*b*) 104 acres.
(*c*) 1,300 feet.	(*d*) 30 feet.
(*e*) 8,250 feet.	(*f*) Banks not specially named.
VII. Ross-Neuhof.	
(18) Oderhafen.	(*a*) 1903.
(*b*) 33 acres.	(*c*) Triangular shape.
(*d*) 36 feet, to be increased to 40 feet.	(*e*) 3,300 feet.
(*f*) Stettiner Ufer (2,150 feet). Breslauer Ufer (1,900 feet).	(*g*) Sheds Nos. 80 and 81
(19) Rosshafen.	(*a*) 1908.
(*b*) 48 acres.	(*c*) 660 feet.
(*d*) 36 feet, to be increased to 40 feet.	(*e*) 4,600 feet.
(*f*) Rossquai (2,400 feet). Vulkanquai (2,750 feet).	(*g*) Sheds Nos. 84 and 85. Used for shipyard purposes.

VIII. Waltershof.

(20) Waltershofer Hafen.
(*b*) 117 acres.
(*d*) 33 feet, to be increased to 40 feet.
(*f*) Predöhlkai (5,150 feet).
Burchardkai (5,000 feet).
(*a*) 1915.
(*c*) 920 feet.
(*e*) 12,400 feet.

(21) Griesenwärder-Hafen.
(*b*) 79 acres.
(*d*) 36 feet, to be increased to 40 feet.
(*f*) North bank (4,250 feet), not specially named so far.
South bank (6,100 feet), not specially named so far.
(*a*) In course of construction.
(*c*) 625 feet.
(*e*) 6,900 feet.

(22) Maakenwärder-Hafen (only partly accessible to sea-going vessels).
(*a*) 1924.
(*c*) 720 feet.
(*e*) No dolphins.
(*b*) 63 acres.
(*d*) 20 feet.
(*f*) South bank, without special name (4,600 feet).

(23) Petroleumhafen.
(*b*) 37 acres.
(*d*) 30 feet.
(*f*) South bank (3,250 feet), not specially named.
North bank (3,250 feet), not specially named.
(*a*) 1913.
(*c*) 490 feet.
(*e*) No dolphins.

The preceding particulars must be supplemented by brief reference to the Holthusenkai on the southern bank of the river in the Veddel district, the water space north of which is not specially divided from the fairway of the river, so that it cannot properly be called an "open-river harbour". The name of the Reiherstieg — the banks of which are equipped with transhipment facilities for sea-going vessels — should also be added to the list of basins, etc., enumerated above.

The entrances to Kuhwärder-Hafen (Vorhafen, 58 acres) and Waltershofer Hafen (Parkhafen, 100 acres), as well as the water areas near the shipyards exclusively used for shipbuilding purposes, have been left out of account in compiling the list.

The Yachthafen (17 acres), occupying the western corner of Waltershof, is not used for transhipment purposes. It provides shelter and berthing space for the numerous yachts frequenting the Elbe, the depth of water within it (26 ft. 6 ins below high water) being sufficient for their needs.

The total area occupied by the twenty-three basins, etc., for sea-going vessels, together with that covered by Werfthafen, Yachthafen, Reiherstieg (partly), and entrances to main basins, is 1,250 acres. The total water frontage is 36 miles, whilst, in addition, there are about 20 miles of rows of dolphins where those sea-going vessels are berthed that are to be loaded and discharged in "midstream".

★

The Basins for Rivercraft.

A description of the basins, etc., for sea-going vessels alone could never convey a complete idea of the Port of Hamburg, because it would contain no reference to one of its most important functions, which is to serve as the connecting link between overseas shipping and the up-river transportation business. The whole port, from the traffic point of view, may be said to have two faces: one looking downstream towards the sea, and another looking upstream towards its hinterland, and this twofold character is also clearly recognisable in the design of each component part. Thus, for instance, most of the basins for sea-going vessels have two entrances: a lower one used by sea-going vessels and an upper one used by rivercraft.

The paramount importance of Hamburg as a river port has already been emphasised in the introduction to this volume. Few people realise the enormous demands for space that have to be satisfied in order to accommodate not only the sea-going vessels, but also the large numbers of barges ministering to their needs. At times, indeed, space has to be found for as many as 2,000 river vessels simultaneously. The measurements of barges of more than 1,000 tons capacity range from 230 to 265 feet in length and from 30 to 33 feet in width, thus exceeding those of many small sea-going vessels. Although the average capacity of barges arriving from the Havel, Spree, and Oder districts is only up to 600 tons, it is nevertheless necessary to make ample provision for the needs of up-river traffic whenever the port accommodation as a whole has to be augmented, because river vessels, owing to the greater dependence of the river traffic on ice conditions, depth of water, and economic fluctuations, generally remain in port much longer than sea-going vessels. It happens, indeed, comparatively often that huge quantities of bulk goods are not discharged from barges until they are actually sold (Fig. 66). Moreover, considerable water spaces of low depth in close proximity to sea-going vessels are not only required for the large up-river barges, but also for the smaller ones, called *Schuten*, which are used for the local traffic within the port. Their registered number is about 5,000 to which must be added 540 passenger boats and tugs and 850 launches.

It is obvious that the transfer of goods between sea-going and river vessels, no matter whether it is effected with or without the use of pier sheds, must take place within the basins, etc., for sea-going vessels. But it is equally obvious that the berths for sea-going vessels would constitute the worst imaginable accommodation for rivercraft, and that it would be economically unsound to utilise deep-water spaces for vessels of low draught. Nevertheless, the principle of linking up the two types of vessels as closely as possible has been carefully and consistently applied throughout. No attempt has been made to assign one compact section of the harbour area to sea-going vessels and another to rivercraft, but to each group of basins for the former has been joined another (of a lower depth of water) for the latter. The relation between the two groups is shewn in the subjoined list.

Accommodation for Sea-going Vessels	*Accommodation for Rivercraft*
A. On the right bank.	
Sandthor-Hafen Grasbrook-Hafen Magdeburger Hafen (southern section) Baaken-Hafen Schiffbauerhafen Strandhafen Kirchenpauerhafen	Magdeburger Hafen (northern section) Binnenhafen Brookthorhafen Ericus-Graben Oberhafen Oberhafen-Canal Deichhafen Billhafen
B. On the left bank.	
Segelschiffhafen Hansahafen Indiahafen Südwesthafen Grenzcanal Reiherstieg Holthusenkai	Moldauhafen Saalehafen Spreehafen Klütjenfelder Hafen
Kuhwärderhafen Kaiser Wilhelm-Hafen Ellerholzhafen Oderhafen Rosshafen	Travehafen Rodewischhafen
Waltershofer Hafen Griesenwärder Hafen Petroleumhafen	Rugenberger Hafen

To the basins for rivercraft enumerated in the right column above must be added the Peutehafen which also contains extensive accommodation for upriver barges but does not belong to any of the groups mentioned.

The total area of the basins for rivercraft, including Billwärder Bucht and Zollhafen to which reference will be made later, is 860 acres. The depth of water ranges from 13 to 20 feet below high water (equal to 6 to 13 feet below low water). Their banks are made to slope — except where they are intended to serve special purposes — and rows of dolphins to which vessels can be moored are in close proximity to them. As a rule, there are additional dolphins near the middle parts of the basins. In order to facilitate the shore communications of barge masters who, together with their families, are often compelled to spend weeks and even months in these basins on board their floating homes, the banks are provided with sets of steps at short distances from each other. Some of them are made accessible by the provision of floating booms.

★

The Canal System.

The rivercraft basins provide safe and unmolested berthing space for up-river barges. There they are unmolested by the brisk traffic in the basins for sea-going vessels, but are nevertheless in close proximity to them. The long trains of up-river barges arriving from the hinterland are separated into their units in the Elbe river before they reach Hamburg, and each barge is allotted its proper berth in one of the basins. The banks of some of these are provided with warehousing accommodation, and where such is the case, part of the cargo is often stored there upon its arrival. By far the greater amount, however, is discharged in the basins for sea-going vessels, and there, too, the return cargoes are taken. For reasons already explained no barge remains any longer in those basins than the work of transhipment requires, and as each may have to discharge into (or load from) several sea-going vessels and to do so at different times, it may have to proceed to and from its berth more than once. Special care has therefore been taken to make the passages between the basins used by the two kinds of vessels as short and as safe as possible. Wherever local conditions permit, short direct water connections have been provided between the upper ends (i. e., those farthest away from the river) of the basins for sea-going vessels and the adjoining ones for rivercraft (e. g., Sandthor-Hafen, Baaken-Hafen, Segelschiffhafen, Hansahafen, Kuhwärderhafen, Kaiser Wilhelm-Hafen, Rosshafen, Waltershofer Hafen). Thus up-river barges are enabled to avoid the main channel of the Elbe and the lower entrances to the basins, these latter being exclusively used by sea-going vessels. The result is that each type of vessel has its own waterways assigned to it so that neither of them can interfer with the movements of the other. This is a great advantage inasmuch as it enhances the safety of harbour traffic, diminishes the risk of accidents, and expedites the work performed by both kinds of vessels.

In order to apply this principle all-round and to make the upper entrances to the basins for sea-going vessels accessible to up-river barges, two belt canals — one skirting the northern, and one skirting the southern edge of the harbour area — have been constructed.

The southern belt canal starts near the eastern extremity of the port, its various sections being designated as follows: Müggenburger Canal — Müggenburger Zollhafen — Müggenburger Durchfahrt — Spreehafen — Veddelcanal — Ellerholzkanal — Rosskanal (Contemplated extension beyond the Köhlbrand: through Rugenberger Hafen).

The northern belt canal consists of Oberhafen-Canal, Oberhafen, Zollcanal, Binnen-Hafen, and Nieder-Hafen (Fig. 67). Vessels with tall superstructures could until lately avoid the Elbe bridges — whose lowest line of structure lies no more than 18 feet above high water — by using Oberhafen-Canal in connection with a branch that links up the belt canal itself with the main river by way of Ericus-Graben, Brookthor-Hafen, and Magdeburger Hafen. All the bridges that cross this waterway at present — one being a roller bridge and five being swing bridges — are provided with movable openings. Since,

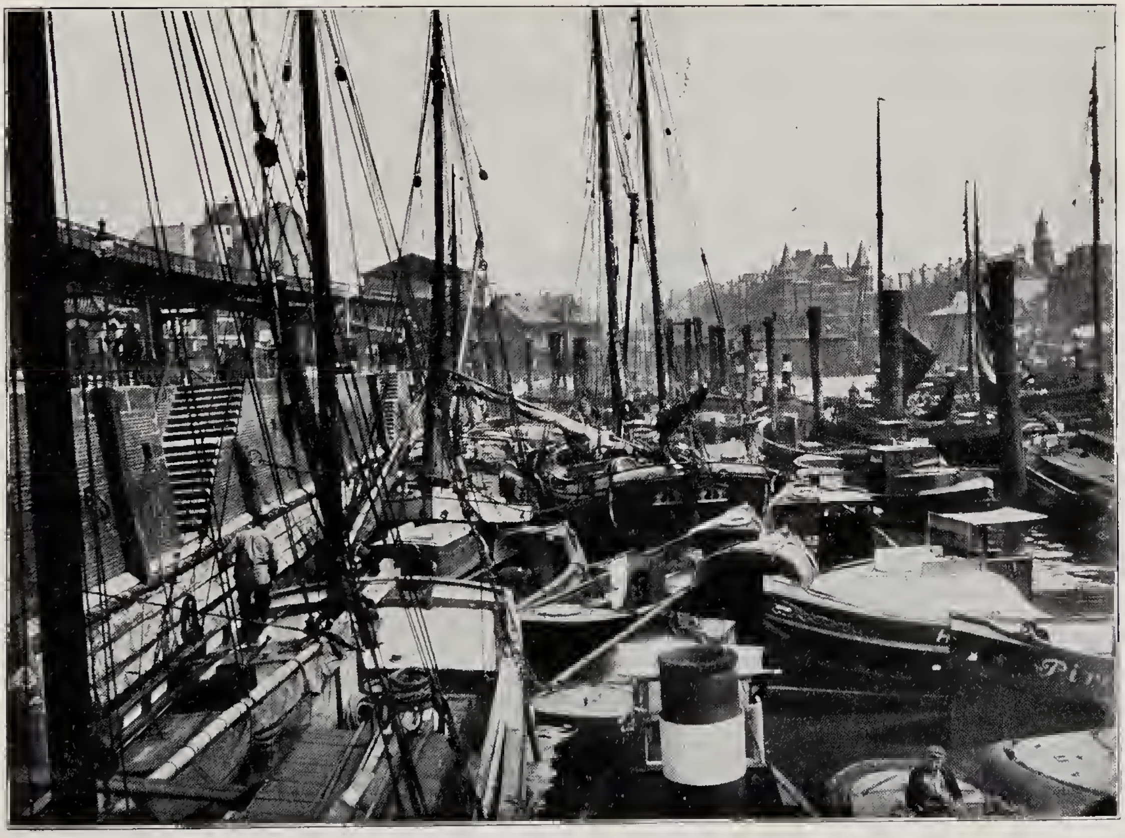


Fig. 5. River and Harbourcraft near Vorsetzen.

however, a sufficient need for opening them is no longer felt, it is intented to build in future fixed bridges only.

In addition to rivercraft, the numerous small lighters for local needs must be accommodated in the shallow-water basins. They are usually berthed where they may be needed from time to time, or where suitable water spaces may be available (Fig. 66, 67). In some cases, however, regular berths are allotted to them in the basins for sea-going vessels.

The sailing vessels engaged in the Lower Elbe and coastal trades (which are usually able to proceed to the high sea as well) are accommodated in Maakenwärder Hafen where the depth of the water is 20 feet, whereas large numbers of tugs and launches may generally be seen, before and after working hours, in the upper portion of Niederhafen off Vorsetzen (Fig. 5) and in Binnen-Hafen.

★

The Goods Sheds used in connection with River-borne Traffic.

It has already been stated that fairly considerable quantities of cargo that are destined for export and reach the port by rivercraft are temporarily transferred to store barges if they are not intended to be discharged into sea-going vessels directly they arrive, and that berthing space is provided for them in all the basins used by river vessels. In addition, however, a number of transit

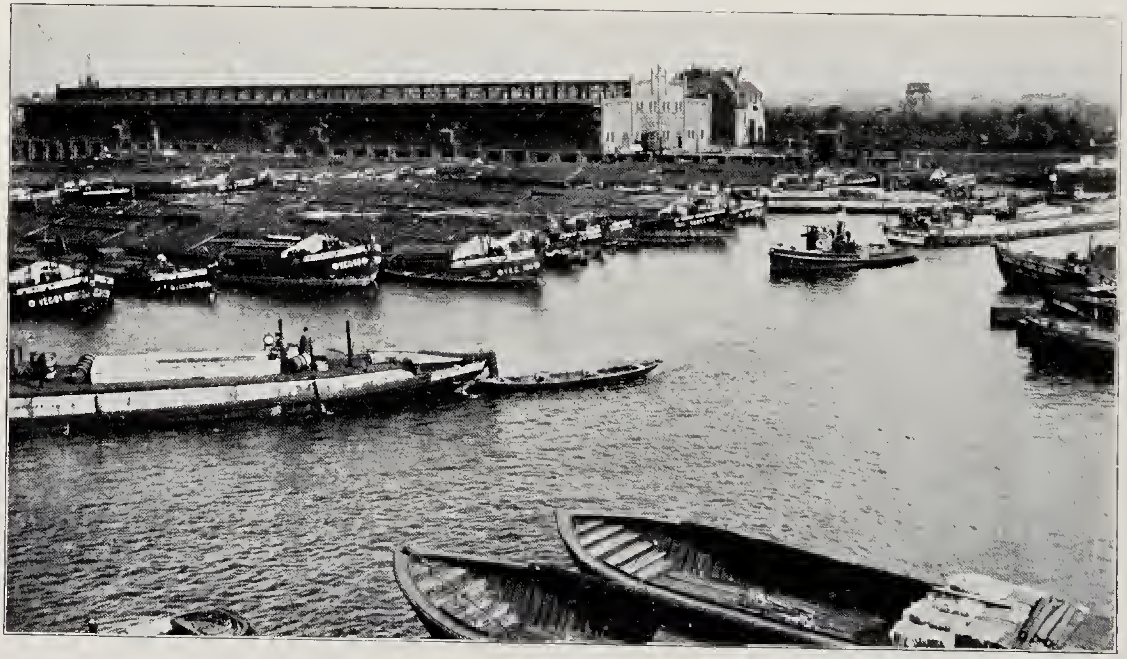


Fig.6. A typical Basin for Up-river Barges (Moldauhafen, shewing Quay Shed on Prager Ufer).

and storage sheds are available for the same purpose. Most of them are owned by the leading companies engaged in river transportation. Thus, the Vereinigte Elbe-Schiffahrts-Gesellschaften own such a shed on Prager Ufer (Moldauhafen) (Figs. 6, 21, 22), which is provided with especially modern and efficient equipment. A detailed description of it will be found in a subsequent chapter. The same company also owns some sheds along Oberhafen between the swing bridge and Erste Hammerbrookschleuse. Not only up-river barges, but also express cargo steamers (some of them with passenger accommodation) to Lauenburg, Lübeck, Saxony, Anhalt, Magdeburg, Berlin and destinations further east, are despatched from Oberhafen and Oberhafen-Canal, and there the Vereinigte Elbe-Schiffahrts-Gesellschaften, the Neue Norddeutsche Flussdampfschiffahrts-Gesellschaft, the Lauenburger Dampfschiffe, and the Schlesische Dampfer-Compagnie Berliner Lloyd A. G. have their cargo sheds or landing stages. The large new two-storied shed near Billhafen, equipped with 5-ton cranes and owned by the last-named company, is one of the most important buildings for river transportation in the port (Fig. 64). Some other storage concerns are domiciled in the so-called Haken. The largest of the Czechoslovak river transportation companies has rented part of Shed No. 49 (Saalehafen) under a lease granted by the Hamburg State.

★

The Locks.

In the harbour basins the water is much calmer than in the open river — a circumstance of great importance to sea-going vessels during loading and unloading, and even more so to up-river barges and lighters. Within the basins, all vessels are protected from the currents caused by incoming and outgoing tides which are very strong at times, and there the work of transhipment is greatly facilitated.

It stands to reason that the elimination of the current in a port accessible at all tides, can only be brought about by providing locks for the *upper* entrances to the various harbour basins, so that, in certain places, rivercraft has to pass through such locks. These locks, however, are altogether different from those used in dock harbours and from canal locks. They are not intended to overcome differences in the level of water, but merely to exclude the current. Although they are of the chamber-lock type and possess upper and lower gates, no time is spent by vessels in waiting for the chamber to be filled or emptied. All that has to be done is to keep one gate always closed, i. e., to abstain from opening one before the other has been closed. The gates are constructed so as to move very freely, and can be opened in one or two minutes. The distance between the two gates of any lock is so large that practically no delay is caused to the passage of vessels, provided these latter are skilfully handled. Moreover, for the double purpose of reducing to a minimum the time spent in locks and of keeping as low as possible the cost of construction, each separate lock is made to serve, as much as possible, the needs of a whole group of basins. In this way it has been found possible to limit the number of locks to six, viz., four on the left and two on the right bank of the Elbe.

The Müggenburger Doppel-Schleuse, located at the junction of the main Elbe and Müggenburger Canal, eliminates the current from the whole district extending from there to the Reiherstieg and containing the Peute, Veddel, and Kleiner Grasbrook basins. The next two locks are Ellerholz-Doppel-Schleuse near Kohlenquai, and Grevenhof-Schleuse between Grevenhofcanal and Kuhwärder-Hafen. They protect the whole of Kuhwärder and Ross-Neuhof, i. e., the district between Reiherstieg and Köhlbrand, against the entrance of the current. The fourth and last of the left-bank locks, Rugenberger Doppel-Schleuse, is located west of the last-named waterway. It leads into Rugenberger Hafen and keeps the current out of the Waltershof group of basins.

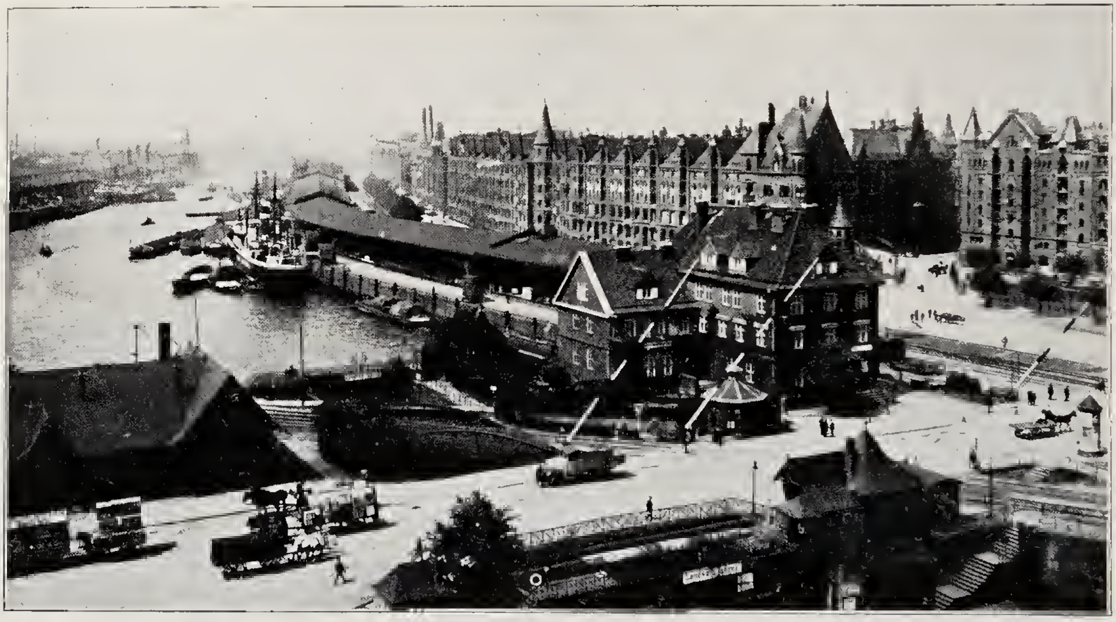


Fig. 7. Sandthorhafen with Sandthorquai and Warehouse Town (Brookthorschleuse and Police Station in the foreground).

Of the two locks on the right bank of the river, the first (Baakenschleuse) is situated in the passage leading from Oberhafen-Canal to Baakenhafen. It exclusively serves the needs of this one basin, whilst the group of basins on Grosser Grasbrook is protected by Brookthor-Schleuse, located between Brookthorhafen and Sandthorhafen (Fig. 7).

These six locks may be said to divide the harbour area into so many sections each of which forms a separate unit from the hydrographical point of view, and, being shut off from the Elbe current, is without any current of its own. Each section, through a number of openings, receives the incoming tide at a certain velocity and retains the additional water until the tide ebbs again. Owing to the dimensions of the six sections the flow of water originated by the tide is so slight that it is practically unrecognisable and does not interfere with the ordinary work going on in the port.

The force of the current that would have to be encountered were it not for the locks must not be underestimated. At times, for instance, it would be strong enough to prevent small vessels without mechanical driving power from making any headway in the narrow passages except with tug assistance.

The locks also serve a useful purpose in that they prevent the current — and therefore also the water power it possesses — from breaking up into small units, thus concentrating this power upon its most important hydrotechnicla task, i. e., the maintenance of the depth of the river and its branches.

As the locks do not directly benefit shipping and as, in the general interest, any delay within them must be avoided, no fees are charged to vessels passing through them.

A description of the locks from the technical point of view will be found in Section III of this volume.

★

The Warehouses.

So far the description given in this book has confined itself to the methods employed for the transhipment of goods and to their bearing upon the design of the port. In a port of worldwide importance, however, the goods discharged are not always directly transferred to some other means of conveyance. In Hamburg, too, the need for an adjustment of demand and supply has become more and more urgent in proportion as the volume of trade passing through the port has increased. Such an adjustment necessitates the storage of the goods in special warehouses.

Quay work and warehousing work are essentially different in their aims and methods, and are therefore performed on altogether separate premises. In Hamburg, moreover, their management rests in entirely different hands. The sole object of the older kind of "midstream" transhipment was to transfer goods to and from sea-going vessels, and this, too, is still the chief object of quay operations at present. During the early years after the introduction of the pier system a favourite description of the pier sheds was that they were "lighters ashore", i. e., contrivances merely intended to relieve the sea-going vessels of their cargoes. Such a comparison, however, is not quite relevant, because in the pier sheds the goods are subjected to a larger number of manipulations than on the lighters during "midstream" transhipment, but it emphasises nevertheless the essential feature of the pier shed system, viz., the principle of retaining the goods no longer than absolutely necessary. When the discharge is completed, the sheds must be emptied again as rapidly as the instructions received from consignees allow, so that room may be provided for the next sea-going vessel and her cargo, because any delay in the despatch of the vessels must be avoided and the expensive sheds must be used in such a way as to be of maximum advantage to all parties. For analogous reasons the goods intended to be loaded must not be delivered until just before the arrival of the vessel that is to receive them. Whenever the transfer from one means of transportation to another cannot be effected as speedily as required, the goods, in the general interest, must be temporarily warehoused. As Hamburg is one of the principal entrepots for goods in transit to other destinations, the prolonged storage of large quantities of them within the harbour area may be considered the rule, and not the exception, and as the majority have come from or are intended for overseas countries, by far the greater part of the warehousing premises must be located in the Free Port area.

Such are the principles that lie at the root of the very considerable warehousing business conducted in the Port of Hamburg. The floor space available in the warehouses covers a larger area than that available in the pier sheds, that of the latter, indeed, only being just about equal to that of the public warehouses (Hamburger Freihafen-Lagerhaus-Gesellschaft) alone, besides which numerous privately-owned concerns are scattered throughout the Free Port area and the rest of the harbour.

Some ports have introduced the principle of building quay sheds and warehouses in close proximity to one another. Hamburg, however, for reasons connected with the nature of the cargo that passes through her port, has not adopted it. The commodities that reach the Port of Hamburg on board the sea-going vessels are of so many kinds and the methods required for storing them are so complicated that it is technically impossible to remove them to a warehouse located in the immediate neighbourhood of the sheds directly after their discharge. The considerations that have to be taken into account when the merchandise is piled up in a warehouse are altogether different from those that apply to a pier shed. Nothing but confusion would result from too close a proximity of the two sets of premises, and the work of transporting the goods from shed to warehouse would be subject to constant delay and obstruction if such a system were adopted. Equally unsatisfactory would be the direct discharge from the ship into the warehouse, because this would greatly interfere with the work of properly sorting the goods according to their marks and destinations. The system, indeed, was given a trial in Hamburg when the first warehouses in the Free Port were designed, and the so-called Kaiserspeicher (Quay Warehouse "A") near Schiffbauerhafen (Figs. 59, 69), was built, but the result of the experiment was not such as to suggest a repetition. It was found that the sites adjoining deep water were so valuable that it would be unwise to utilise them for any purpose but the loading and unloading of sea-going vessels.

The plan ultimately adopted for the warehouses of the Freihafen-Lagerhaus-Gesellschaft was to build them in two compact groups occupying different parts of the Free Port area, viz., one on either side of the river. The group on the right bank, a veritable warehouse town (Figs. 7, 67, 74) nearly a mile long and more than three hundred feet wide, is within easy reach of the stock exchange and the City. Its seventeen warehouse blocks cover the long but narrow island which is surrounded by Ericusgraben, Brookthorhafen, and Sandthorquai on one side, and by Zollcanal and Binnen-Hafen on the other, and which extends from Oberhafen in the east to Nieder-Hafen in the west. It occupies the northernmost section of the Free Port area. Each of the two (or three) rows of warehouses has a road connection on one side, and is adjacent to a canal, suitable for rivercraft, on the other. This means that the pier sheds are accessible from there by lorries or by lighters. Railway connection, except in the case of a few warehouses on Sandthorquai, has been dispensed with, because, generally speaking, the harbour railways are not intended to move goods from one part of the harbour to another. In addition to the Kaiserspeicher already mentioned the company operates another large warehouse (Quay Warehouse "B") near the western extremity of Brookthorhafen

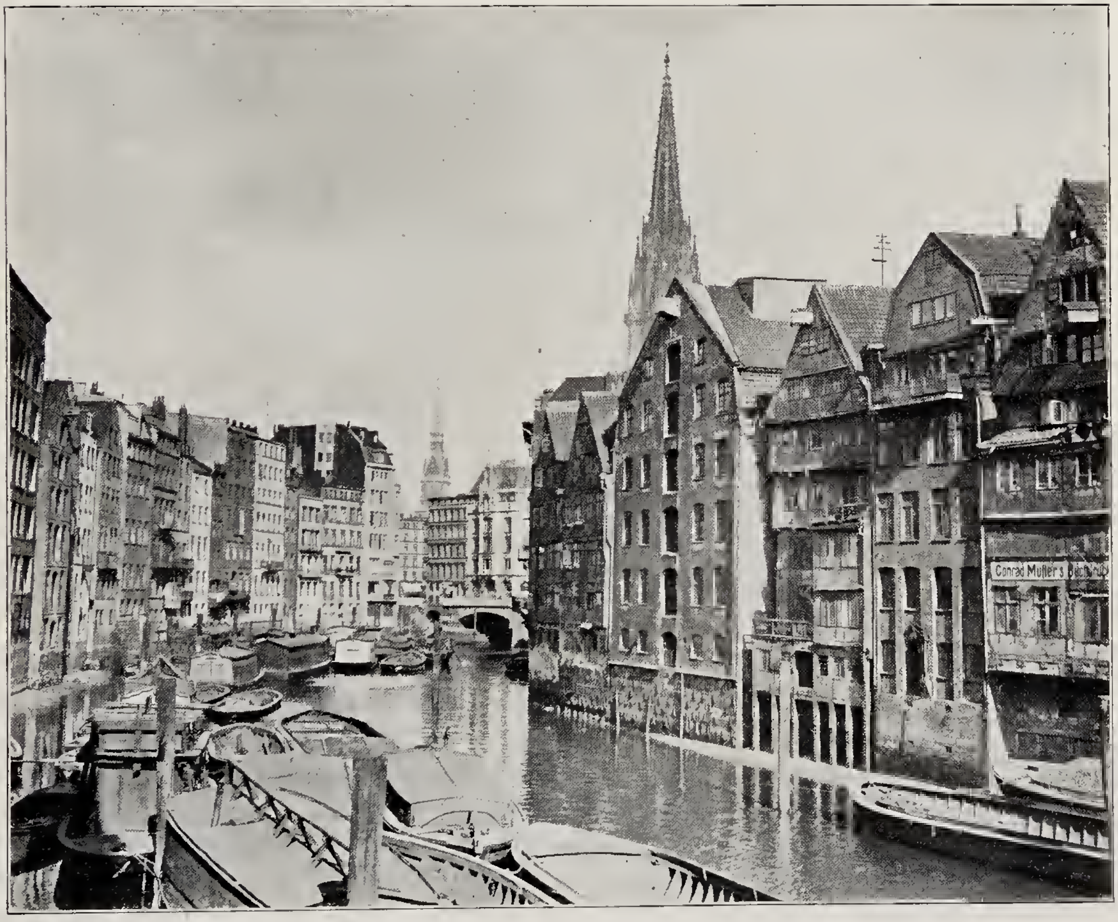


Fig. 8. Nicolaifleth (mouth of River Alster), the original Harbour.

The second group of warehouses owned by the company consists of eight buildings situated on the left bank of the river in Saalehafen and Moldauhafen, two basins provided with rivercraft depth. These warehouse premises are lower than those referred to above.

The preceding account shows that there are only three piers for sea-going vessels, viz., Sandthorquai, Asiaquai, and Segelschiffquai, where pier sheds and warehouses are found in close proximity to one another, and even there it is scarcely more than a topographical accident (Fig. 7). In the whole harbour there is only one pier shed (No. 35 on Asiaquai) which is directly connected with the warehouse located in its immediate rear (on Melniker Ufer). This is effected by a conveyor belt carried right across the road. This arrangement, however, is an experiment too, and owes its origin to the special requirements of the cotton trade.

A considerable number of private warehousing concerns have also settled in the Free Port area, most of their premises being located on Grenzcanal and Reiherstieg and on the canals branching off from these waterways. Special mention should be made of the grain warehouse owned by the Getreide-Lagerhaus-Gesellschaft which is situated on Mittelufer in Kuhwärderhafen and is equipped with compressed-air discharging appliances. In the same basin, adjoining Sheds Nos. 69 and 70, the Lager- und Speditionsgesellschaft owns some warehouses which, as regards their situation, resemble the abovementioned Kaiserspeicher inasmuch as they are also located near deep water. Finally, there are numerous warehouses in the older portions of the City (and therefore outside the Free Port), which, generally speaking, have waterway connection with the harbour area by means of the Alster and the narrow canals (called *Fleete*) intersecting those parts (Fig. 8).

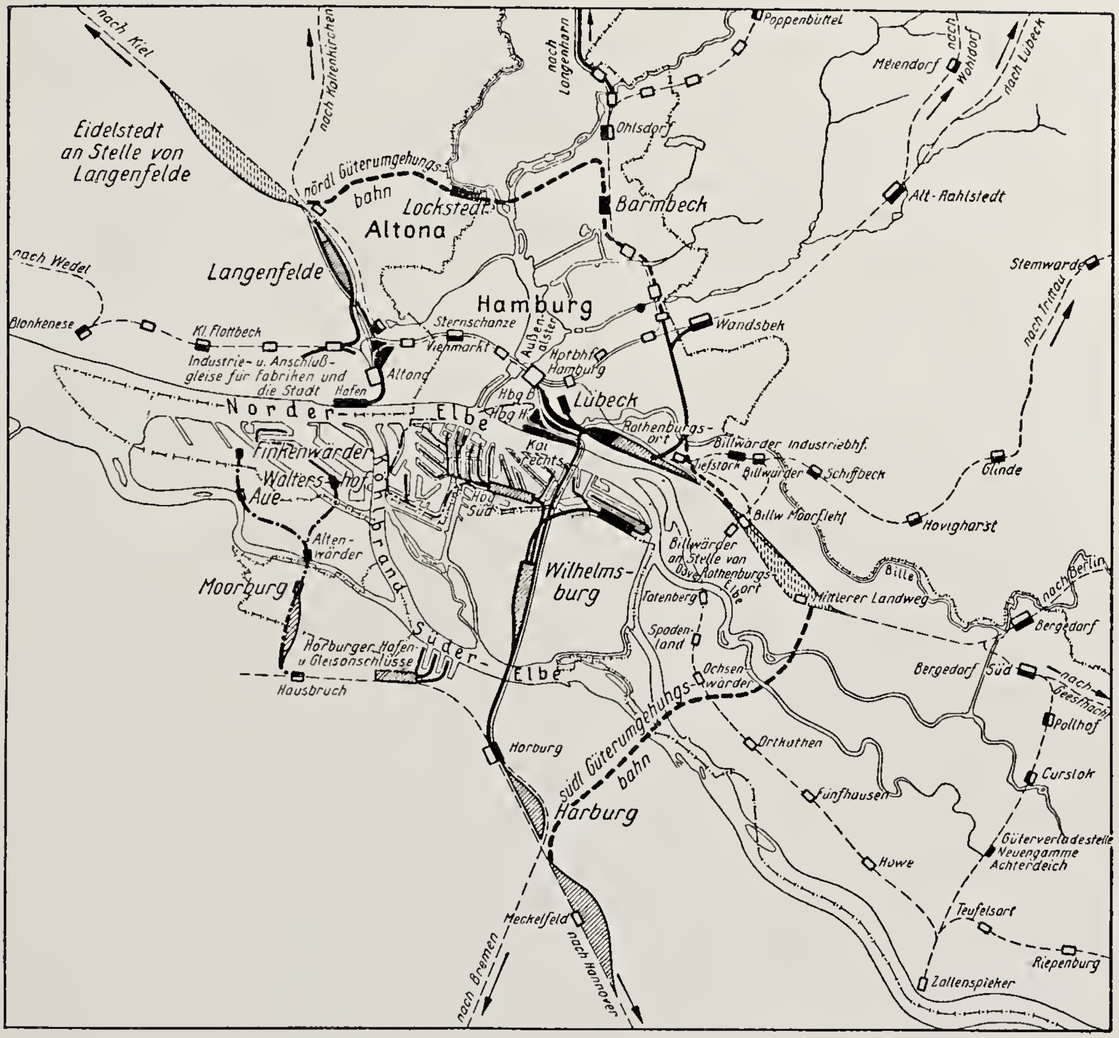
★

Railway Facilities.

It is but natural that the general design of the Port of Hamburg should be determined, in the first place, by the needs of its water-borne traffic, although it goes without saying that those of its land-borne traffic have by no means been lost sight of. This is most clearly seen in regard to its railroad facilities. The importance of the goods receiving stations and the loading installations in the harbour can be properly appreciated only within the framework of an account dealing with the entire railway system of the Free City of Hamburg and the neighbouring districts. The working of the harbour railways, indeed, cannot be understood unless treated in conjunction with the total movement of goods to and from the economic unit of which Hamburg forms the centre.

It has already been pointed out in the first section that Hamburg is one of the most important German cities with respect to the extent of her rail traffic. By far the largest percentage of this traffic emanates from the harbour although, as has been stated, the latter is by no means a pronounced "railway

Map. No. V.



The Goods Stations in Hamburg and the surrounding district.

harbour". Despite the fact that the up-river barges very considerably relieve the railways as regards the transportation of merchandise to and from the Port of Hamburg, its rail traffic with its hinterland as may be inferred from the extensive facilities scattered throughout the area, is also very important. In this, as in the general design and equipment of the harbour basins, may be seen the great importance played by the combination of bulk goods and package freight in the trade of the Port of Hamburg.

Map No. V supplements the harbour plan by giving a general view of the railway connections of the district surrounding Hamburg, Altona, and Harburg — a district which, from the traffic point of view must be treated as an inseparable whole.

The subjoined description takes no account of the passenger traffic. The facilities provided for the goods traffic are (1) shunting stations, (2) goods receiving stations, (3) distribution shunting centres, (4) loading sidings and track connections between the various stations. The functions performed by them are so different that each must be described separately.

The incoming trains are first sent to the shunting stations which, as regards their size and their situation, but not as regards their number, correspond to the six main lines of traffic enumerated on page 12 and to their relative importance. Three such stations have been found sufficient, viz., Wilhelmsburg for the lines from the south (Hanover), south-west (Bremen), and west (Cuxhaven), the junction of which is at Harburg; Rothenburgsort for those from the east (Berlin) and north-east (Lübeck); and Eidelstedt for those from the north (Kiel). The lines from the north were served until recently by the Langenfelde shunting station situated close to Altona. The trains ordinarily sent to Wilhelmsburg shunting station are sometimes sent to Harburg to relieve the traffic.

One only of the three shunting stations, viz., Rothenburgsort, is actually situated in Hamburg territory. Wilhelmsburg has the largest accommodation (4,500 trucks daily), Eidelstedt (4,000 trucks) taking the second, and Rothenburgsort (3,000 trucks) the third place respectively. The figures given in brackets, however, do not convey a correct impression of the demands the three stations are expected to satisfy. Eidelstedt, the most modern of them, does indeed suffice for the needs of the traffic from the north, but the two others are no longer adequate. Rothenburgsort is now required to serve as a loading station as well, and will soon have to cede its function as a shunting station for the eastern and north-eastern traffic to a new station further east on the line to Berlin now in course of construction. The new station will be of very large dimensions. It will be named after the locality where it is situated, viz., Billwärder, and will be connected with a separate goods-distributing station for the Billwärder industrial district.

Wilhelmsburg, too, no longer satisfies modern requirements. Local conditions there, as at Rothenburgsort, prevent any material extension of the site, and it has been decided to relieve it of part of its traffic. This will make it necessary to break up and to rearrange the trains arriving from the south and south-west — the line from Cuxhaven not supplying any goods traffic worth mentioning — before they reach Wilhelmsburg. The former sorting station at Meckelfeld on the line from Hanover, south of Harburg, is now subjected to structural alterations to make it suitable for its new task, which is to distribute the incoming trains among Wilhelmsburg and Billwärder.

In order, however, to carry this plan into effect and to deviate from Wilhelmsburg the trains intended for Billwärder, it will be necessary to construct a connecting line between Billwärder and Meckelfeld. This line will be known as *Südliche Güterumgehungsbahn.* It will start at the eastern end of Billwärder Station and cross the Dove Elbe, Gose Elbe, and the main river in a south-westerly direction. Its continuation in the opposite direction will be the *Nördliche Güterumgehungsbahn* which will skirt the outlying districts of Hamburg in a huge curve *via* the goods receiving stations of Barmbeck and Lokstedt and effect a connection between the Billwärder and Eidelstedt shunting stations. The construction of such lines for the goods traffic through outlying parts has become a problem with which most large cities have to grapple. In Hamburg it has been found necessary to thus divert the goods traffic because the Junction Railway connecting Hamburg and Altona can no longer cope with the enormous goods traffic from the east and south to the north that moves over its four tracks. Just as the *Südliche Güterumgehungsbahn* is to link up the southern and south-western traffic with Billwärder, a branch of the *Nördliche Güterumgehungsbahn* starting at Wandsbek is intended to connect with it the traffic from the north-east (Lübeck). This branch line is the only section of the *Nördliche Güterumgehungsbahn* that has been completed so far. Its present terminus, however, is not Billwärder, but — pending the completion of that station — Rothenburgsort.

The shunting stations just enumerated have to serve the needs of the goods receiving stations of the district, including the operation of the traffic to and from the harbour.

The two main harbour stations are Kai-rechts on the right, and Hamburg-Süd on the left bank of the Elbe. There are also two subsidiary stations of local importance, viz., one in the Peute district connected with Wilhelmsburg only, and one at Ross. The former is intended to serve the needs of the Peute industrial district, and the latter — which is connected with Hamburg-Süd — those of the newly opened-up Ross harbour area.

At the two main harbour stations the trucks that compose the trains arriving there from the shunting stations are distributed over the quays and private sidings, and those arriving from the latter are collected. The stations also attend to the clearance of the goods through the customs, because they are located in the Free Port area, whereas the shunting stations are all situated on Customs Union territory. Owing to such clearance work the premises and installations of the harbour stations have to be even larger than the volume of traffic passing through them would alone necessitate.

Kai-rechts Station is situated at the rear of the quay sheds on Versmannquai, on the northern shore of Baakenhafen. Its northern limit coincides with the customs frontier which will be described in detail in a subsequent section. It is connected with the goods receiving station of Hamburg-H or Hannoverscher Bahnhof located in the area of the Customs Union just across the customs boundary. The length of the tracks of Kai-rechts Station is $7^1/_2$ miles. Including its loading sidings, it can accommodate up to 750 trucks. Its eastern limit is formed by the Elbe bridges. The recently completed third Elbe bridge is intended to connect it with the stations situated in the Free Port on the left bank of the river, and this connection nowhere crosses the customs frontier. Kai-rechts serves the requirements of thirty-nine quay sheds, five warehouses, four industrial concerns (including the gasworks on Grosser Grasbrook between Strandhafen and Magdeburger Hafen) and the coal transhipment plant on Kirchenpauerquai. This latter plant, by which inland coal is transferred to sea-going vessels, is under the management of the National Railway Company. The work carried on there considerably adds to the tasks that have to be performed by Kai-rechts. In addition to the purposes just mentioned, Kai-rechts also serves the needs of two special sheds that owe their existence to certain technical matters connected with the customs. One of them is the so-called Collecting Shed (*Sammelschuppen*) on the east bank of the part of Magdeburger Hafen used by rivercraft. There imported piece goods arriving from the Free Port are collected, and the consignments are combined to form carloads which are to pass in bond through the area of the German Customs Union or are destined for bonded warehouses within Germany. In the Distributing Shed (*Verteilungsschuppen*) situated at the eastern extremity of Kirchenpauerquai the reverse operations take place, i. e., the carloads of piece goods that are intended for exportation and reach the shed in bond are transferred to sea-going vessels.

Most of the vessels served by Kai-rechts are engaged in the European trade or on the African berth. Package freight forms the major part of their cargoes, and the discharging of consignments of southern fruit is one of the functions specially attended to by this station.

The second of the chief harbour stations, viz., Hamburg-Süd, is situated south of the main Elbe on the northern shore of Spreehafen and Veddelkanal and extends from the entrance to Saalehafen to Reiherstieg. It is much larger than Kai-rechts. It serves the needs of forty-one quay sheds — from which big transoceanic freighters are despatched, and which, generally speaking, are much more spacious than those on the right bank of the river — as well as those of a considerable number of warehouses and storage places (including very extensive coal depôts) and numerous industrial concerns (including the large shipyards). The total number of undertakings connected with this station is 136, and the total length of tracks is 36 miles. The average number of trucks handled daily is about 2,000, but the maximum capacity of the station is as much as 3,000. More than 4,100 trucks can be accommodated by the loading and siding tracks belonging to the station. The true significance of these figures can only be grasped if we bear in mind that the clearance through the customs alone takes several hours and that a good deal of complicated shunting is required in connection with it. The Ross Station on the south bank of Rosskanal is intended to relieve Hamburg-Süd. It is only partly completed so far and the length of its tracks is about five miles.

For the time being, Hamburg-Süd also attends to the rail traffic needs of the section of the port situated west of the Köhlbrand, i. e., those of the Petroleumhafen on Waltershof and the Deutsche Werft on Finkenwärder. It is quite capable of satisfying the demands thus made on its resources. The objections raised by Prussia to Hamburg's desire to construct a railway bridge across the Köhlbrand have necessitated the provision of a train-ferry connection 1,300 feet north of the entrance to Rosskanal and Rugenberger Schleusen where the Köhlbrand is about 1,000 feet wide. Each of the two steamers put into the service can carry six railroad trucks, and the maximum number of trucks that can be taken across in either direction is about 220 a day. In the rear of each landing place there is a shunting yard where trains may be broken up or assembled as the case may be. On Waltershof the tracks lie on the southern shore of Waltershofer Hafen, encircle Petroleumhafen, and are continued to Finkenwärder and the Deutsche Werft by means of a bridge across the Köhlfleth.

The growing needs of traffic have now required a further extension of the port facilities in the Waltershof section, and the train ferry is no longer adequate to cope with them. The projected Finkenwärder Railway is intended to provide an additional means of communication. It will link up Waltershof and Finkenwärder and will branch off from the line from Hamburg to Cuxhaven. It will relieve Hamburg-Süd of part of its traffic. It will start at Hausbruch, proceed in a northerly direction and divide into two minor branches, viz., one to Waltershof, and another to Finkenwärder. The Waltershof terminus will be built on a site between the Köhlfleth and Griesenwärder Hafen (now in course of construction). The Waltershof branch is nearing completion, but the construction of that to Finkenwärder has been temporarily postponed. The Köhlbrand train ferry will continue to be used even after the completion of the Waltershof rail connection, but only for the piece-good traffic to Waltershof in carloads, for train marshalling purposes, and for traffic going north. It is merely a question of time when a tunnel under the Köhlbrand — designs for which have already been prepared — will have to replace it.

The foregoing description gives a complete account of the railway stations, etc., in the Free Port area. Their functions are supplemented by the numerous private sidings and by the still more numerous public sidings serving the loading places for sea-going vessels. The former are merely used in connection with the loading and unloading of trucks, whereas the latter, in addition, are employed for classifying the trains — which, until then, have only been arranged according to quays — in such a way that trucks serving the same quay sheds are grouped together. To effect the necessary shunting, a number of tracks — generally three, but sometimes four or five — have been constructed behind the rows of quay sheds, but only the first or second of them is used for a loading siding. One — or, in the case of the most modern sheds, two — additional loading sidings are provided between the sheds and the water's edge in order to enable the shipments arriving by rail to be transferred to the vessels direct. The whole system of tracks on the quays may be regarded as an adjunct to the harbour stations, and as these are all connected with one another, the entire port may be looked upon as a single huge shunting and loading station in which the quay sheds, as regards some of their functions, correspond to the freight sheds that form part of every goods station.

Two of the goods receiving stations situated in the Customs Union part of the harbour have already been mentioned. They are Industriebahnhof Peute on the left bank of the river, which is independent of Hamburg-Süd, and Hannoverscher Bahnhof on the right bank adjacent to Bahnhof Kai-rechts. Peute station is located south of Müggenburger Kanal on a site that belongs partly to Hamburg, and partly to Prussia. The length of its tracks is $9^1/_2$ miles.

Hannoverscher Bahnhof (called Hamburg-Han or Hamburg-H for short) has waterway connections on the Oberhafen-Canal and Oberhafen side where the necessary loading plant is also provided. It has accommodation for 590 trucks. The swing bridge across Oberhafen-Canal connects it with Rothenburgsort, and that across Oberhafen with the Hamburg Central Station *(Hauptbahnhof)*.

The greater part of the railroad facilities described so far (total length of track 230 miles) constitutes the Port of Hamburg Railway *(Hamburger Hafenbahn)*. It has been constructed and is being maintained by the Hamburg government, and new extensions are added whenever the needs of traffic require it.

For completeness' sake the foregoing enumeration of goods receiving stations in the Port of Hamburg must be supplemented by the addition of a few others also situated in Greater Hamburg. The loading station of Hamburg-B (Berliner Bahnhof) with accommodation for 800 trucks and the station of the Lübeck-Büchener Eisenbahngesellschaft with accommodation for 170 trucks are both connected with Rothenburgsort Shunting Station. Bahnhof Sternschanze (200 trucks), a station on the Hamburg-Altona Junction Railway (*Stadtbahn*) serves the special needs of the cattle traffic. Two additional loading stations are located in the northern districts of Hamburg, viz., at Barmbeck (200 trucks) and Ohlsdorf (30 trucks). Finally, there are certain stations in the neighbouring cities of Altona and Harburg — equipped with extensive quay and industrial sidings — that must also be looked upon as parts of the great rail traffic organisation that serves Greater Hamburg.

The railroad facilities described in this chapter can accommodate — in their present state of completeness — about 11,000 trucks. This accommodation will considerably increase after the extensions already referred to have been added. Hamburg will then be in a better position than it is even now to cope with any amount of rail traffic that is likely to converge upon it, even if an unexpected rush should set in at any time. Fluctuations in the economic position often give rise to such sudden increases. It is of paramount importance that Hamburg should always be prepared for a rush, because the major part of the traffic to and from its hinterland will have to move by rail whenever, owing to ice conditions or drought, the waterways are temporarily unavailable for transportation purposes.

The foregoing account shews that the two principal links connecting the port with its hinterland supplement each other in their respective tasks.

They take charge of the goods arriving from overseas destinations as promptly as possible and deliver in good time the consignments intended for sea-going vessels. The excellent communications between the basins for rivercraft and the goods receiving stations on the one hand, and the quays for sea-going vessels on the other, ensure the speedy and reliable cooperation of these three important adjuncts to traffic.

★

Road Traffic in the Harbour.

Whereas the tracks of the Port of Hamburg Railway are chiefly used to connect the loading places in the harbour with the railway system of the hinterland (which means that they serve the needs of long-distance traffic), local harbour traffic — or at least that part of it that moves on land — is principally effected by road vehicles. Every day an immense number of vehicles enter the harbour area from the goods receiving stations outside the harbour and from the numerous storage places and industrial works of the big city in order to convey merchandise to the quayside and *vice versa*. The motor lorry with or without trailer has begun to take more and more the place of the horse-drawn lorry, and has even entered into successful competition with the railway for long-distance traffic. The result is that very considerable demands are made on the roads in the harbour. This, of course, applies with particular force to the approach roads from the city.

As regards the part of the harbour located on the right bank of the Elbe — which is mainly reserved for the piece-good traffic — its principal road connection with the "old city" *(Altstadt)* is *via* Kornhausbrücke, a bridge that crosses the Zollcanal about halfway down its length. From there vehicular traffic radiates in all directions and reaches every part of the Grosser Grasbrook harbour basins. Four additional road bridges on the edge of the city relieve the pressure on the principal approach road.

The division of the harbour area located on the left bank of the river has road connection with the city in two places each of which is the centre of very dense traffic. One is near the up-river boundary of the Free Port where the two road bridges repeatedly mentioned cross the Elbe, one being situated within, and the other without the Free Port area. The other is near the centre of the whole port at a place where the connection of the two banks is affected by the Elbe Tunnel. Elsewhere will be found a description of this important piece of engineering which consists of two parallel tube shafts and enables vehicles and pedestrians to cross the Elbe from St. Pauli to Steinwärder and *vice versa* below the river bed. Two systems of roads, viz., the Veddel roads starting from the Elbe bridges, and the Grevendamm-Reiherdamm thoroughfare starting from the Elbe tunnel, connect these two traffic centres with the main artery of road traffic which extends lengthwise from Saalehafen to the Köhlbrand. Its first part, called Veddelerdamm, leads past the Hamburg-Süd shunting station. It then crosses the Reiherstieg by one of the two swing bridges and runs parallel to the Hamburg State boundary (Rossdamm) along Travehafen and Rosskanal until it terminates near the Köhlbrand, its direction being from east to west at first and from north to south afterwards.

The projected Harbour Express Railway *(Hafenschnellbahn)* is intended to follow the route just described. It is to branch off from the existing Elevated and Underground Railway *(Hoch- und Untergrundbahn)* and to cross the Elbe *via* the new (third) bridge recently opened to traffic. Every bridge this railway will have to pass, including that across the Elbe, has already been provided with a high-level surface way for its accommodation. To cope with the expected increase in the passenger traffic, plans have also been prepared for a branch express line starting from the swing bridges across the Reiherstieg and leading to the Elbe *via* Steinwärder where a second tunnel would have to be built to effect a connection of the Express Railway system with the existing Hochbahn near St. Pauli Landing Stages and thus to complete the circle. It is also contemplated to extend the Köhlbrand express line to Waltershof and Finkenwärder, which will require the tunnelling of the Köhlbrand and the Köhlfleth. The plans for such western extension however, are not likely to assume practical shape until the harbour basins west of the Köhlbrand have been more or less completed. On the other hand, the construction of the circular line just described would have been taken in hand long ago had it not been for the war and its economic consequences.

From the two main thoroughfares intersecting the harbour minor ones branch off in all directions, especially to the loading and discharging places of the sea-going vessels where direct connections are established with the transhipment facilities on the quays.

Up to now the Waltershof harbour basins that are in course of construction have no road connection with the rest of the harbour area. Vehicular traffic to and from that part, however, is but small and its needs are looked after by the train ferry. It is believed that this means of communication will prove sufficient for some time to come, because the Waltershof area has provisionally been reserved for the transhipment of bulk goods, and their conveyance usually takes place by rail or by lighter. If, at some later date, the transhipment facilities of Waltershof are increased still further, a proper road connection by means of a tunnel will become indispensable.

★

The Facilities for Passenger Traffic.

Some reference to the demands on the passenger traffic in the harbour has already been made in the chapter dealing with the road traffic, where a few particulars concerning the Harbour Express Railway *(Hafenschnellbahn)* have also been given. These demands are very considerable indeed. If we bear in mind that, on an average, the harbour provides employment for 60,000

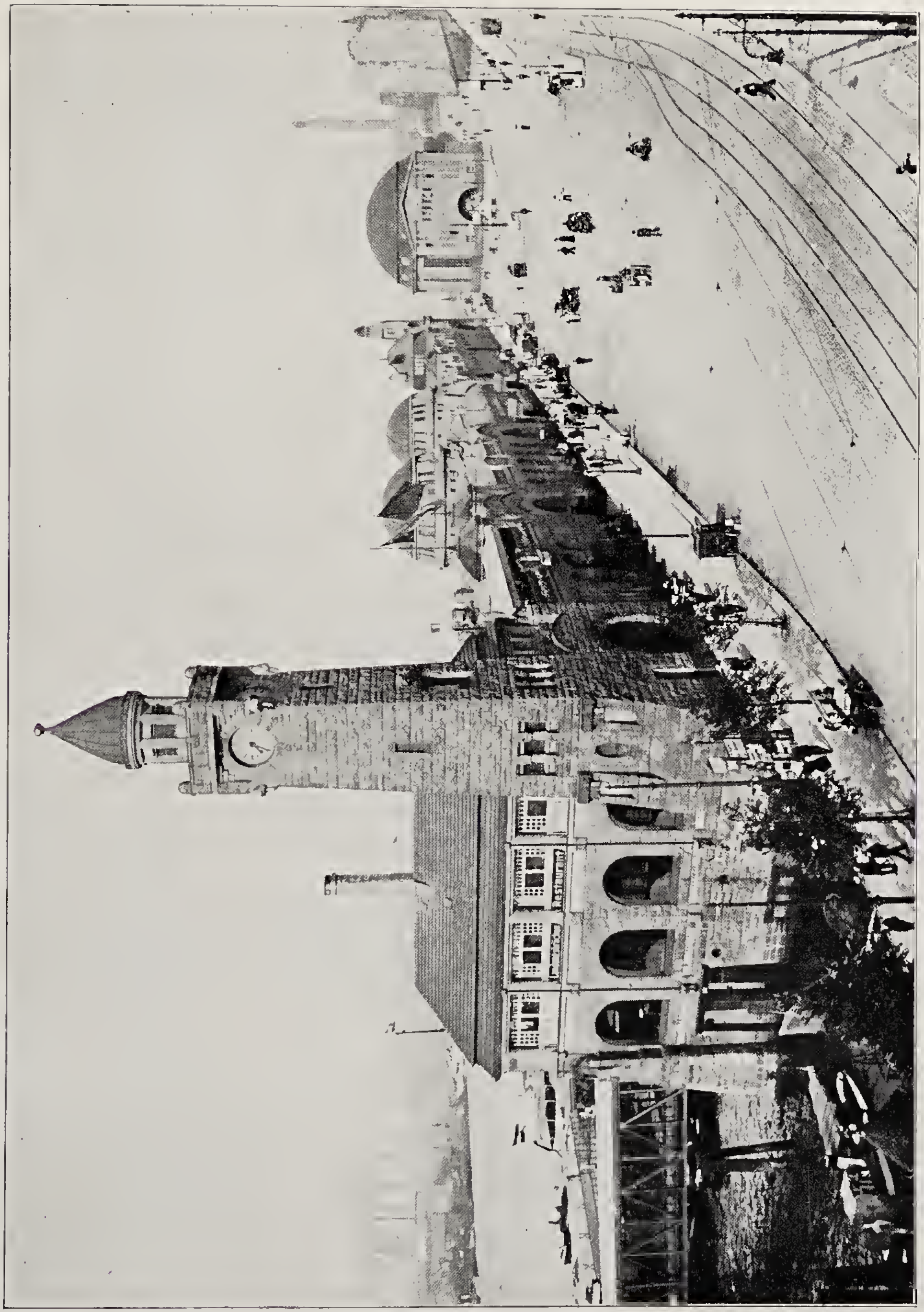


Fig. 9. St. Pauli Landing Stages and Entrance Hall to the Elbe Tunnel.

workmen and that it is also frequented by numerous business men, officials, and ship's passengers — whose numbers it is impossible to ascertain from statistical sources — we obtain an approximate idea of the extent of this traffic. The difficulties connected with its organisation are certainly not lessened by the fact that the area available for residential purposes in the State of Hamburg is very limited. In the chapter describing the State boundary it has been shewn that the harbour section and the residential section could expand in opposite directions only, viz., the former towards the west and the latter towards the north. Both the topographical situation and considerations connected with the interests of shipping prevented the provision of additional residential quarters within the harbour area or in close proximity to it. Sooner or later it will be necessary to come to some agreement with Prussia regarding the removal of the difficulties, but even now traffic facilities have to be provided for no less than about eighty thousand persons journeying to and from the harbour area twice daily, viz., before and after working hours. On a rough estimate about 80% of these persons have to cross the Elbe.

The only rigid connections between the two river banks are the three bridges and the tunnel. The distance between them is 2½ miles. Alone they are insufficient to cope with the enormous traffic, so that they have to be supplemented by water connections. This public service is performed by about 60 fast ferry steamers of large type, each with accommodation for a number of persons ranging from 125 to 2,200 (Figs. 70, 72). There are regular services at all hours of the day. Moreover, most of the large shipyards, steamship companies, and other private undertakings convey their employees to and from their places of work in boats of their own. Finally, there are the boats of the so-called *Jollenführer* (watermen) plying between the shore and the ocean-going vessels berthed in midstream, and a large number of State-owned and private launches.

So large and brisk a traffic requires a considerable number of landing stages. The cityward bank of the river is lavishly equipped with them, the biggest of all being the St. Pauli Landing Stages (Figs. 9, 42). They are 1,400 feet long and, occupying a site near one of the main junctions of the city's traffic, they not only serve the needs of the harbour, but also those of the vessels engaged in services between Hamburg on the one hand and Harburg, the Lower Elbe stations, and the North Sea bathing resorts on the other, as well as being used by overseas liners. The most suitable landing places for the purposes of the general passenger traffic in the harbour are the projecting headlands (locally called *Höfte*) of the narrow peninsulas separating adjacent harbour basins (Figs. 59, 65, 77). These and numerous other places, e. g., the bases of the peninsulas just referred to, are provided with landing facilities wherever the needs of the traffic have made such provision desirable. A more detailed account of the landing facilities — the total number of which is 272 — will be found in a subsequent section.

The Free Port and the Customs Facilities.

In conformity with the general plan of this section — which is to point out the leading factors that have influenced the design of the Port of Hamburg — the present chapter is intended to shew how considerations connected with customs matters have brought about a division of the port into two different sections, viz., a Free Port *(Freihafen)* section, and a Customs Union *(Zollinland)* section.

When, in 1871, the German Empire was re-established, Hamburg retained the right to remain outside the German Customs Union. The anomalous position, however, resulting from this circumstance, greatly inconvenienced the interchange of goods with the hinterland of the port, and in the end Hamburg — which had gradually developed into the premier seaport of the united Empire — consented to renounce her privilege. She joined the Customs Union in 1888 with her entire territory, except that occupied by her port and that intended for its future extension. The Free Port thus created includes all the land and water areas between the Elbe bridges and the Köhlbrand. After the war the greater part of the new harbour basins constructed on the island of Waltershof was also excluded from the Customs Union.

The adoption of the Free Port principle has enabled Hamburg to greatly accelerate the despatch of vessels. The latter are not subjected to any custom-house examination on entering either the Elbe estuary or the Free Port area, nor are the goods carried by them liable to any customs dues. The ships are taken to their berths without any delay, and are at liberty to start their discharge at once. Although during their passage up the Lower Elbe they are passing through the area of the Customs Union, they nowhere come into contact with the shore, so that technically they remain abroad. The pilot taken on board is sworn in as a customs officer and sees to it that the customs regulations are duly complied with. His presence is shewn by the black and white customs ensign which is hoisted as soon as the ship enters the estuary of the Elbe. During the night a green and white stern light is used for the same purpose. Once the goods have arrived within the Free Port, they may be discharged, sorted, and stored without the payment of any customs duty and without any customs supervision. They may, indeed, be manipulated in any way to which goods are usually submitted when they are in port. Raw materials may even be converted into semi-finished articles without paying the duty. This latter regulation has greatly promoted the development of the port into a centre of the transit trade by sea, and has caused numerous industries to settle there in addition to the old-established shipbuilding industry. The advantages they enjoy consist in the duty-free admission of the raw material, the duty-free exportation of the semi-finished products, and the saving of the cost of transport between the place of manufacture and the seaport.

The duty only becomes payable when goods intended to be imported into the Customs Union territory cross the Free Port boundary. For better control, goods are only allowed to enter or leave the Free Port at a few places where customs officers are stationed. Elsewhere the customs boundary is carefully protected by special contrivances, both ashore and on the water.

On the accompanying map of the Port of Hamburg the Free Port area is distinguished from that of the Customs Union area by a darker shade of colouring. The boundary line of the older Free Port section, i. e., that above the Köhlbrand, starts at the up-river limit of the area suitable for sea-going vessels, where it crosses the main stream west of the old railway bridge. From the northern end of the bridge it skirts Baakenhafen, separates the Free Port station of Kai-rechts from the Customs Union station of Hamburg-Han., passes through Brookthorhafen, skirts the eastern extremity of the warehouse town and runs along the southern shore of Zollcanal and Binnen-Hafen until it reaches the main river at the lower end of Nieder-Hafen. Then it again crosses the main stream — which, as may be seen, flows through Free Port territory for a distance of about 2½ miles — and reaches the southern bank near the entrance to the Elbe tunnel and close to the shipyard of Messrs. Blohm & Voss. It next follows the water's edge though keeping at some distance from it (the strip thus included in the Free Port being used for shipbuilding purposes) as far as the Kuhwärder Vorhafen, crosses the lower part of the latter, and runs parallel to the eastern side of Kohlenschiffhafen as far as the Köhlbrand. Beyond Rosskanal it sharply turns east and approximately coincides with the State boundary as far as the Reiherstieg which is crossed near Ellerholzschleusen. It then skirts the southern bank of Spreehafen as far as the railway line from Hamburg to Harburg with which it coincides until it returns to the point where it started, viz., the Elbe bridges. The section of the Free Port thus included covers an area of 2,700 acres.

The other part of the Free Port, i. e., the Waltershof section, comprises for the present the water spaces and embankments of Petroleumhafen, Parkhafen, Waltershofer Hafen, and Rugenberger Hafen, totalling 640 acres. This area will be subsequently enlarged.

The customs boundaries of the two sections are carefully guarded by high iron railings on shore (Fig. 43) and by floating palisades where they run across water spaces (Figs. 59, 77). Openings of more or less considerable width are only provided at the entrances to the various basins, in the Kuhwärder Vorhafen, and in Parkhafen, where the work of supervision is carried out with the aid of customs launches.

The customs supervision of the harbour railway stations and of the gates by which traffic enters and leaves the Free Port, as well as all clearance matters, are attended to by the eight chief custom-houses and their branch offices (Figs. 59, 67). Each chief custom-house is situated near the boundary of the Free Port area, and a number of subordinate custom-houses are affiliated to each. Special custom-house surveyors are appointed to take charge of the customs matters connected with each municipal district. It has already been stated that no duties are collected from any sea-going vessels entering or leaving the free port where the customs administration, on principle, does not interfere. The various custom-houses merely look after matters connected with the passenger, vehicular, and local waterway traffic. The clearing offices for the rail-borne traffic are located at the harbour railway stations.

The subjoined list contains some particulars of the various customs offices dealing with the harbour traffic.

A. On the Right Bank of the Elbe.

(1) The Jonas Chief Custom House near St. Pauli Fischmarkt between St. Pauli Landungsbrücken and St. Pauli Fischhalle.
  (a) The St. Pauli Markt- und Landungsplatz Clearing Station. — (Floating landing stage. Pedestrian traffic.)
  (b) The Landungsbrücken Custom House. — (Near St. Pauli Landungsbrücken. Passenger steamer traffic).
  (c) The Hafenthor Clearing Station (Above St. Pauli Landungsbrücken. Pedestrian traffic).
  (d) The Vorsetzen Custom House (Floating landing stages near Nieder-Hafen. Local waterway traffic).

(2) The Kehrwieder Chief Custom House (Poggenmühle, at the eastern extremity of the warehouse town).
  (a) The Niederbaum Custom House (Western extremity of the warehouse town. Pedestrian, vehicular, and local waterway traffic).
  (b) The Auf dem Sande Custom House (Near Binnen-Hafen. Pedestrian and vehicular traffic, postal parcels for the Free Port area).
  (c) The Baumwall Custom Warehouse (Western extremity of Binnen-Hafen).

(3) The St. Annen Chief Custom House (Near Zollcanal).
  (a) The Brook Custom House (Zollcanal west of Kornhausbrücke. Clearing on land and water, more especially for passengers and luggage).
  (b) The Jungfernbrücke Clearing Station (Zollcanal west of the Brook Custom House).
  (c) The Kornhausbrücke Custom House (Zollcanal east of Kornhausbrücke. Pedestrian, vehicular, and local waterway traffic).
  (d) The Wandrahm Custom Warehouse (Same as the preceding).

(4) The Ericus Chief Custom House (Teerhof, eastern extremity of the warehouse town).
  (a) The Hauptgüterbahnhof Custom Houses (Collection and delivery of goods. Express goods traffic).
  (b) The Versmannquai Custom House (Teerhof. Rail traffic of the right-bank section of the Free Port).
  (c) The Teerhof Custom Warehouse (Teerhof. Rail traffic).

(5) The Lohseplatz Chief Custom House (South bank of Brookthorhafen).
  (a) The Meyerstrasse Custom House (Same premises. Pedestrian, vehicular, and local waterway traffic).
  (b) The Brookthorhafen Custom House (Floating landing stages near the north bank of Brookthorhafen. Local waterway traffic).
  (c) The Zweibrückenstrasse Custom House (Near the Elbe bridges on the right bank of the river. Pedestrian and vehicular traffic).
  (d) The Baakenschleuse Custom House (Eastern extremity of Baakenhafen. Local waterway traffic).

N. B. The Cuxhaven Custom House is also affiliated to the Lohseplatz Chief Custom House.

(6) The Oberelbe Chief Custom House (Entenwärder and special harbour basin for customs matters, Zollhafen).
  (a) The Entenwärder Custom House (Same premises. Up-river barge traffic).

B. On the Left Bank of the Elbe.

  (b) The Veddel Custom House (East of Moldauhafen. Pedestrian and vehicular traffic).
  (c) The Südbahnhof Custom House (At Bahnhof Hamburg-Süd. Rail traffic of the left-bank section of the Free Port).
  (d) The Müggenburg Custom House (Müggenburger Zollhafen. Local waterway traffic, especially Elbe barges).

(7) The Steinwärder Chief Custom House (Near the southern entrance to the Elbe tunnel).
  (a) The Elbtunnel Custom House (Same premises. Pedestrian and vehicular traffic through the Elbe tunnel).
  (b) The Fährcanal Custom House (Shore premises and floating landing stage near entrance to Fährcanal. Pedestrian and local waterway traffic).
  (c) The Kuhwärder Custom House (Floating landing stage near Tollerort) and the Ross Clearing Station (Lower entrance to Rosskanal). — (Pedestrian and local waterway traffic).
  (d) The Parkhafen Custom House (Floating landing stage near Athabaskahöft), the Rugenbergen Clearing Station (Rugenberger Schleusen) and the Yachthafen Clearing Station (Western extremity of Petroleumhafen). — (Pedestrian and local waterway traffic).
  (e) The Reiherstieg Custom House (Near the customs boundary in the Reiherstieg. Local waterway traffic).
  (f) The Ernst August-Schleuse Custom House (Western extremity of Potsdamer Ufer in Spreehafen. Pedestrian and vehicular traffic).

Besides the above-mentioned seven chief custom-houses there is one more at Ericus for the supervision of the customs boundaries.

It may be assumed that the forty-one customs stations of various kinds by which the customs boundary is controlled will always be able to cope with the traffic however heavy it may be.

From the above account it will be seen that the Free Port area includes:

(1) All basins for sea-going vessels except Nieder-Hafen and Kohlenschiffhafen which latter is situated just above the mouth of the Köhlbrand. It is not necessary for the British coal handled there to be unloaded in extra-Customs Union territory.

(2) Most of the basins used by rivercraft and most of the canals. Hence the entire traffic between the berthing spaces for barges and lighters and the transhipment places for sea-going vessels is also exempt from control by the customs authorities. The basins, etc., excluded from the Free Port, are: Billwärder Bucht; Peutehafen; the two customs harbours *(Zollhäfen)* referred to above; the industrial canals above the Elbe bridges; the belt canal *(Zollcanal)* skirting the southern limit of the city and the small basins adjoining it, and (in the Waltershof section) Maakenwärder Hafen and Yachthafen.

(3) Numerous industrial concerns (cf. the next section of this book), especially shipbuilding yards for large vessels, except the yard of the Deutsche Werft on Finkenwärder.

(4) Some of the harbour railway stations and some warehouses both public and private.

★

The Industries domiciled in the Port.

Some prominent industrial undertakings have always been domiciled in the harbour area. The left bank of the river was an industrial district long before the construction of any harbour basins was under contemplation. The tendency on the part of industries to migrate from the interior of the country and to settle in the seaports became particularly noticeable when it was found necessary to cut down expenses, especially the cost of the transportation of raw materials and manufactured articles. Hamburg, too, found herself obliged to open up additional industrial districts within and in close proximity to her harbour in order to satisfy the demands for sites with waterway connection.

The advantages enjoyed by works domiciled in the Free Port consist in saving (1) the cost of transportation from the place of production to the place of transhipment and (2) the duty ordinarily payable on imported raw material. Hence, most of the Free Port industries — with the exception of the shipbuilding industry, which has always been settled there — belong to the class of those by which raw material is converted into semi-manufactured articles. These, of course, largely contribute to the considerable export and import trade with overseas countries. Generally speaking, most of the industrial concerns of Hamburg dependent on the supply of imported raw material are domiciled within or close to the harbour area, though not necessarily in the Free Port, and a good many of these, too, enjoy the advantage of possessing direct waterway communication with the harbour basins.

The shipbuilding industry and those allied to it, especially those engaged in the production of boilers, ship's engines, and ship's equipment, are domiciled both in the Free Port and in the Customs Union part of the harbour. It has already been stated that only the most recent addition to the number of big yards, viz., the Deutsche Werft (established in 1916), is not located in the Free Port area. Its yard at Finkenwärder covers 94 acres. Its principal slipways on Finkenwärder directly adjoin the main stream and admit of considerable extensions. The most easterly of the inlets cut into the land is suitably arranged for equipment purposes, and plants for the building of small vessels have been installed near the mouth of the Köhlfleth channel. The older ones among the big shipyards, without exception, occupy sites in the Free Port. That of Messrs. Blohm & Voss, for instance, (140 acres, established in 1877), is located in the Steinwärder district between the Northern Elbe and Kuhwärderhafen, the northern bank of which is used by the firm as an equipment quay. There, among others, the biggest crane in the Port of Hamburg (of a capacity of 250 tons) may be seen. Messrs. Blohm & Voss, like all other yards, not only turn out cargo steamers and high-class passenger boats, but also undertake repairs. They own several floating docks, the largest of which has a capacity of 81,000 tons. Floating docks are the only kind of docks to be met in the port: there are no graving docks whatever. Part of Kuhwärderhafen has been provided with a greater depth than the rest in order to accommodate the large dock of Messrs. Blohm & Voss (Fig. 10). The other docks are located near the main river and in the Werfthafen basin (a branch of the Vorhafen) where new vessels are launched. The oldest-established of the big Hamburg yards is the Reiherstieg Schiffswerft (Reiherstieg - Deutsche Werft-A. G.), dating back to 1857. It occupies an area of 22 acres on both sides of the

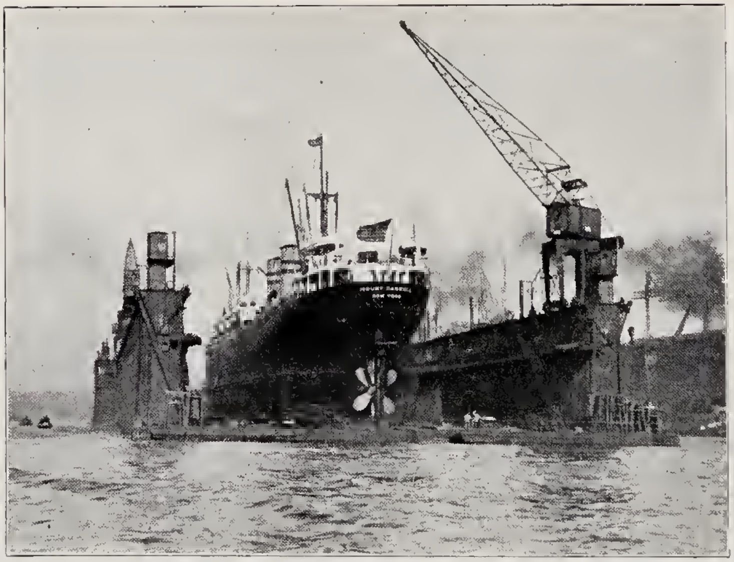


Fig. 10. A Floating Dock.

Reiherstieg, and is separated from the site used by Messrs. Blohm & Voss by the yard of Messrs. H. C. Stülcken Sohn (1858; 8 acres), so that the whole river front between Vorhafen and Grenzcanal is utilised for shipbuilding purposes. Further south, the Deutsche Schiffs- und Maschinenbau-A. G., Werk Vulcan — the third of the big shipbuilding yards — have leased a site (77 acres) extending from the Vorhafen — where their vessels are launched — to Rosskanal. Their equipment quay (Vulcanquai) adjoins Rosshafen, and contains a 200-ton crane, the largest but one in the Port of Hamburg. The basin west of the area occupied by the Vulcan-Werke — whose principal establishment was domiciled at Stettin prior to 1906/8 — is used by them to accommodate their floating docks, etc. That portion of the west bank of the Vorhafen which is included within the Free Port is occupied by the Schiffswerfte und Maschinenfabrik vorm. Jansen & Schmilinsky (established in 1858, covering 16 acres). The preceding enumeration of shipbuilding yards might be supplemented by a long list of smaller concerns. Between them the Hamburg yards can turn out any type of vessel, from the biggest ocean liner to the smallest launch, barge, or lighter, and they are also prepared to undertake any kind of repair work that may be required of them. Apart from the big shipyards there are but few industrial works domiciled in the harbour that occupy sites adjacent to water spaces deep enough for seagoing vessels. Their number includes the Municipal Gasworks on Grosser Grasbrook west of Magdeburger Hafen, which receive their coal from the sea-going vessels direct; the Norddeutsche Kohlen- und Koks-Werke on Indiaquai (Indiahafen), to which the same remark applies, and a few others situated near the northern (deep-water) part of Reiherstieg, e. g., a guano factory, a copper smelting work, an oil refinery, and a coal depôt.

Most of the industrial establishments, however, have to be content with sites adjacent to canals with rivercraft depth, because, generally speaking, those near deep water are intended to be used for discharging and loading purposes. Industrial sites are much in demand, but they are leased to such concerns only as can shew that their settlement in the harbour area does not conflict with the interests of the port as a whole, and that it is essential for them to be thus connected with it. This, therefore, chiefly applies to the exporting industries.

The Port of Hamburg comprises three large industrial districts, each of which forms a compact whole and has been equipped for its intended purpose by adequate levelling-up and by the provision of canals, roads, and railway facilities. The oldest of the three is the Free Port industrial district on Kleiner Grasbrook and Steinwärder (Fig. 11) to which repeated reference has already been made. It is intersected by canals branching off from the main river and the Reiherstieg and having a width of 100 to 160 feet, and has excellent rail connection with Hamburg-Süd railroad station.

The other two industrial districts are located east of the Elbe bridges in the Customs Union section of the port. The one south of the river, viz., the Veddel

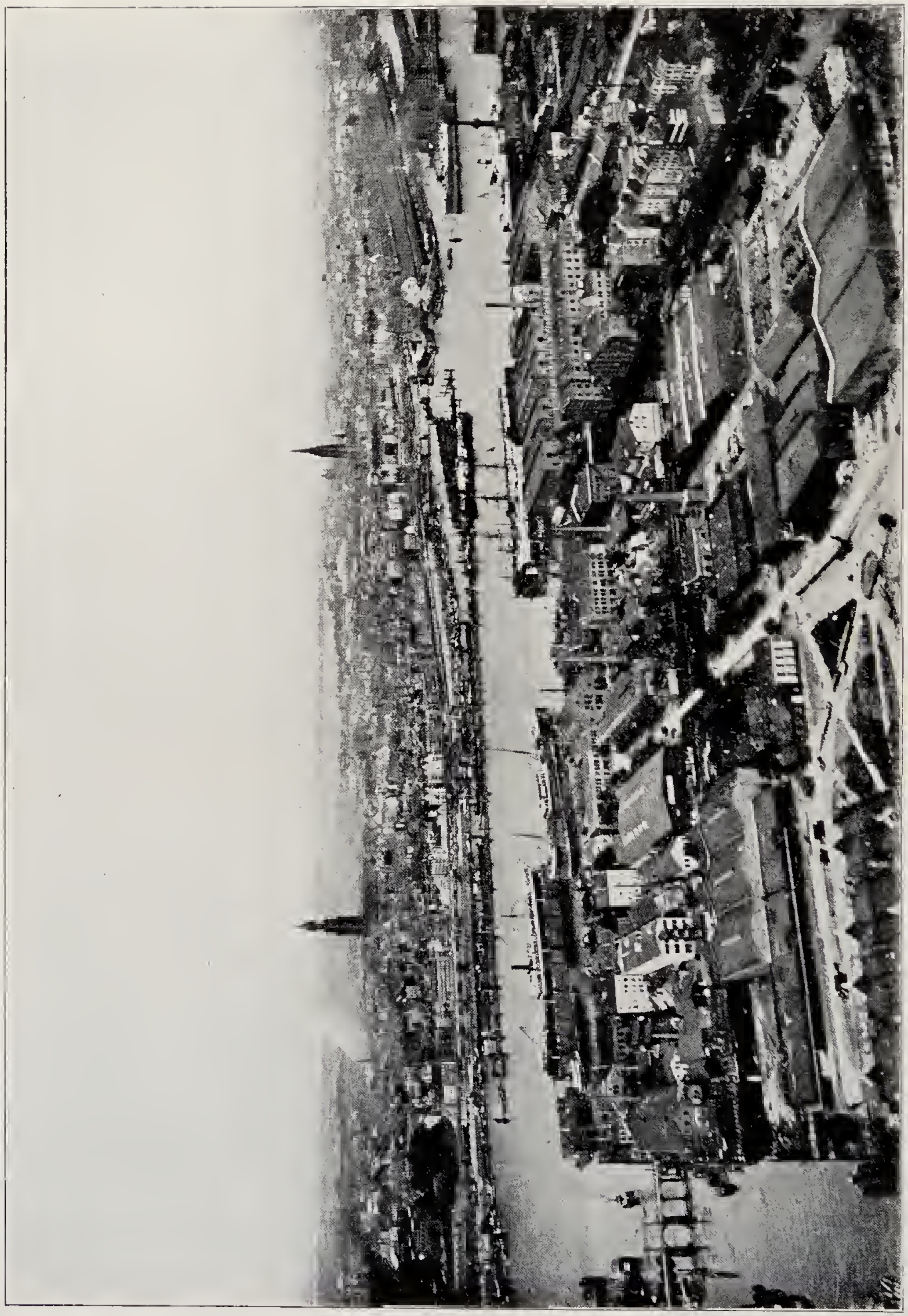


Fig.11. The Steinwärder Industrial District in the Free Port zone (With view of the City and the Alster in the background).

and Peute district, has already been developed as much as the Free Port district just described. Müggenburger Canal and Hofe Canal, which are connected with one another by Moorcanal and with the main Elbe by Peute Canal, make this area easily accessible to rivercraft and harbour vessels. The loading railway station specially built for it has already been mentioned. The road bridge across the Elbe affords a convenient means of reaching the city. Part of the suburb of Veddel is residential in character, but there are also some large industrial works which are accessible from the water side by way of the Markt-Canal. The shipbuilding industry, too, has taken advantage of the facilities offered, and several yards have been built on sites adjacent to the river. The most important of the concerns settled in the Peute section is the Norddeutsche Affinerie which occupies huge premises on Müggenburger Canal and whose demand for further accommodation was one of the reasons that made it necessary a short while ago to rebuild part of Peute Station on Prussian territory just south of the boundary.

The right bank of the Elbe above the bridges contains the premises of the customs authorities on Entenwärder and the filter works of the Municipal Waterworks on Kaltehofe. What is now Billwärder Bucht and Holzhafen was formerly a sharp curve of the main Elbe, but a cut was made through the Kaltehofe peninsula and the river was given its present course which is more suitable for shipping. A waterway branching off from Billwärder Bucht is Tiefstack-Kanal. It is accessible through locks, and connects with the River Bille and the canal system of Billwärder Ausschlag. Just above the locks referred to an open-tide canal — which higher up divides into three arms — also branches off from Billwärder Bucht. It provides waterway communication for a large part of the Billwärder-Moorfleth district which has been considerably levelled up lately. By all these waterways direct connections with the harbour are afforded and a very extensive area intended for industrial purposes is opened up. Its development is in full progress. The industrial railway from Rothenburgsort provides the necessary means of communication with the hinterland.

Just as the "old city" *(Altstadt)* with its shallow canals *("Fleete")* and warehouses partly owes its distinctive character to its proximity to the harbour, the general appearance of the residential quarters west of the Bille is largely affected by the numerous factories established there. This applies more particularly to the densely populated Hammerbrook district, the various canals of which are connected with the Oberhafen, and thus with the harbour area, by two locks. Moreover, owing to the fact that the River Alster and its canalised tributaries intersect the city in various directions, several other more or less residential districts situated a long way from the harbour also communicate with the latter through their waterway connections.

The three chief industrial districts of the harbour, i. e., Steinwärder-Kleiner Grasbrook, Veddel-Peute, and Billwärder-Moorfleth, together with the shipyards scattered throughout the port, occupy a combined area of 2,800 acres, which is about half that used for actual shipping purposes. This proportion shews the important rôle played by the industries domiciled in the Port of Hamburg. The above-mentioned industrial districts not directly adjacent to the harbour area are, of course, not included in the total given.

The subjoined tables indicate the relative importance of the various harbour industries settled in the area defined above.

When judging the relative importance of the various industries, we must remember that the size of the area occupied by each is a better guide than the number of workmen employed. The latter figures represent the maximum numbers of workers employed in 1923/25 — a period during which the majority of works required less workmen than in pre-war times and less than the capacity of their plants permitted.

Name of Industry	No. of Works	Area covered in acres	No. of Workmen
(1) Shipbuilding and allied industries	90	501.0	19,960
(2) Chemical industry	32	84.0	1,486
(3) Building industry and manufacture of building material	13	51.8	574
(4) Coal utilisation, incl. gasworks	6	49.4	1,071
(5) Oil and grease manufactories	19	45.1	1,695
(6) Flour mills, etc.	13	32.4	1,106
(7) Woodworking and timber industries	43	32.0	1,637
(8) Iron and metalworking industries	24	31.9	1,003
(9) Metallurgical industry	3	29.8	1,652
(10) Electricity works	6	28.1	527
(11) Dyeworks and paint factories	10	12.6	399
(12) Foodstuffs	12	5.9	204
(13) Engine building, excluding ship's engines	8	4.4	317
(14) Brewing industry	3	2.5	307
(15) Rubber industry	2	2.3	1,284
(16) Iron and metal foundries	9	2.2	235
(17) Electrical industry	5	1.5	186
(18) Guts and sausage skins	2	0.8	180
(19) Miscellaneous industries employing less than 100 workmen	18	19.4	492
Totals	318	937.1	34,315

The above 318 works are distributed over the three industrial districts of the harbour as follows:

I. Free Port and Customs Union Area below the Elbe Bridges (Grosser Grasbrook, Waltershof, and Finkenwärder).

Name of Industry	No. of Works	Area covered in acres	No. of Workmen
(1) Shipbuilding	59	465.0	10,206
(2) Coal and gas	4	24.8	977
(3) Oils and greases	13	19.4	1,086
(4) Flour mills, etc.	7	14.8	423
(5) Chemical industry	11	10.3	262
(6) Foodstuffs	9	5.2	155
(7) Wood, incl. timber	9	4.3	643
(8) Metallurgical industry	1	3.6	235
(9) Dyes and paints	7	2.8	71
(10) Iron and other metals	11	2.4	359
(11) Engine building	3	1.9	174
(12) Rubber industry	1	1.7	1,240
(13) Foundries	6	1.5	204
(14) Building material	2	0.7	35
(15) Guts and sausage skins	1	0.4	65
(16) Electrical industry	1	0.1	11
(17) Miscellaneous	6	3.5	244
Totals	151	562.4	25,363

II. Peute and Veddel (above the Elbe Bridges, left river bank, Customs Union area).

Name of Industry	No. of Works	Area covered in acres	No. of Workmen
(1) Shipbuilding	16	31.9	406
(2) Metallurgical industry	1	17.8	1,017
(3) Chemical industry	3	16.8	140
(4) Building material	6	16.6	313
(5) Wood, incl. timber	15	12.3	518
(6) Oils and greases	4	11.1	465
(7) Iron and other metals	5	10.1	245
(8) Flour mills, etc.	3	9.1	382
(9) Coal and gas	1	4.1	47
(10) Brewing industry	2	1.7	107
(11) Engine building	1	1.6	10
(12) Electrical industry	1	0.1	2
(13) Foodstuffs	1	0.1	26
(14) Miscellaneous	5	4.5	59
Totals	64	137.8	3,748

III. Billwärder, Moorfleth, Billbrook, Tiefstack (above the Elbe Bridges, right river bank, Customs Union area). — Sites having water connection are included only.

Name of Industry	No. of Works	Area covered in acres	No. of Workmen
(1) Chemical industry	18	58.5	1,084
(2) Building Materials	7	34.6	264
(3) Electricity works	3	28.0	511
(4) Coal and gas	1	20.4	47
(5) Iron and other metals	8	19.4	399
(6) Wood, incl. timber	19	15.2	476
(7) Oils and greases	2	14.9	144
(8) Flour mills, etc.	3	8.9	291
(9) Metallurgical industry	1	8.4	400
(10) Dyes and paints	3	8.0	418
(11) Shipbuilding	15	3.6	274
(12) Electrical industry	3	1.4	172
(13) Engine building	4	0.8	160
(14) Brewing industry	1	0.7	200
(15) Foundries	3	0.7	31
(16) Foodstuffs	2	0.7	23
(17) Rubber industry	1	0.6	44
(18) Guts and sausage skins	1	0.4	115
(19) Miscellaneous	8	11.7	151
Totals	103	236.9	5,204

Grand Totals.

Name of District	No. of Works	Area covered in acres	No. of Workmen
I. Free Port, etc.	151	562.4	25,363
II. Peute-Veddel	64	137.8	3,748
III. Billwärder, etc.	103	236.9	5,204
	318	937.1	34,315

If we take the number of persons employed for a basis of comparison, we find that the harbour industries represent about 25$^0/_0$ of the industrial activity of Hamburg as a whole. In 1925 there were counted 7,709 works in the State of Hamburg, and the number of persons employed by them was 133,550. These figures shew that the largest industrial works are situated within the harbour area.

* * *

Facilities for Special Purposes.

The present chapter is intended to supplement the preceding general description of the port by special reference to some facilities provided for particular purposes.

Mention should be made, in the first place, of the contrivances used in connection with the transhipment of certain goods requiring special treatment, e. g., foreign fruit (of which very considerable quantities are imported). As the last-named commodity has to be protected against the danger of frost, five special fruit sheds equipped with central heating and heat-insulated walls and roofs have been built, viz., Fruit Sheds A and B and Quay Sheds Nos. 22 and 23 on Versmannquai (Baakenhafen), and Fruit Shed C (Magdeburger Hafen). (Figs. 12, 20.)

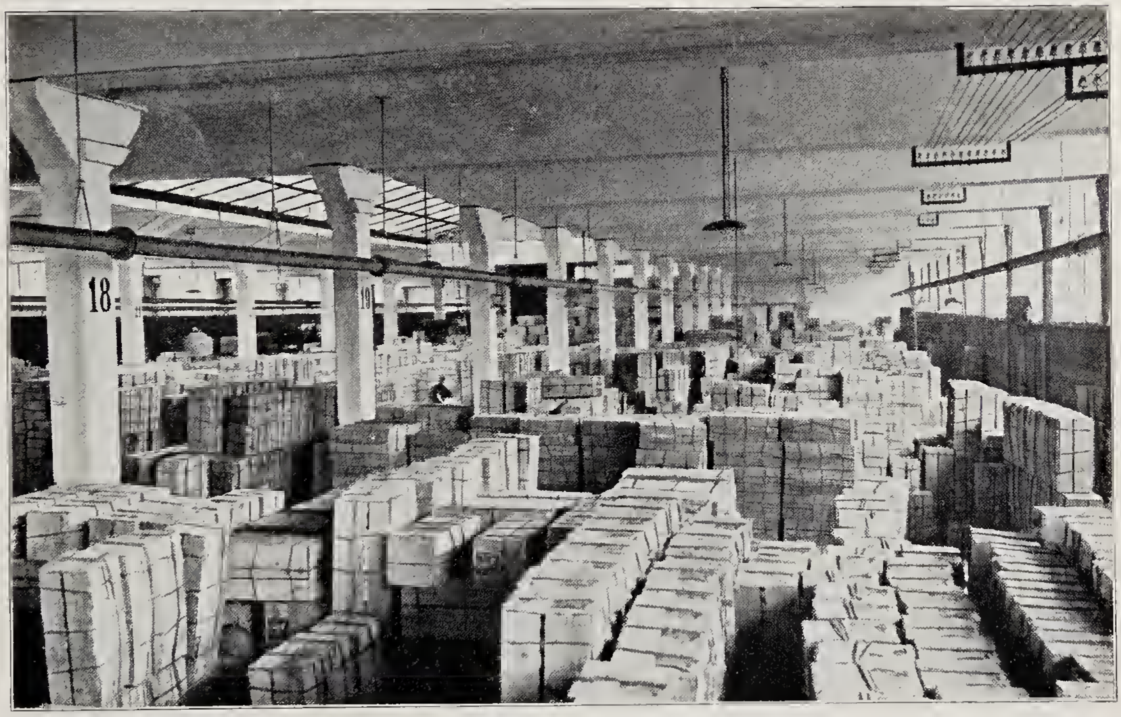


Fig. 12. View of Fruit Shed "C", upper storey.

All these five sheds occupy sites that are located on deep water. A special shed used for the distribution of fresh fruit imported by ocean-going steamers, but subsequently transferred to harbourcraft or railroad trucks, has been built on a site adjacent to shallow water in Oberhafen, immediately above Oberhafenbrücke. This shed has an upper storey directly accessible to railroad trucks, the railway line being of elevated construction in that neighbourhood. It is situated in the immediate vicinity of the large central market place *(Zentralmarkt)* on Deichtor, which can be reached from the waterside by means of a spacious landing stage. The fruit, vegetables, and flowers grown

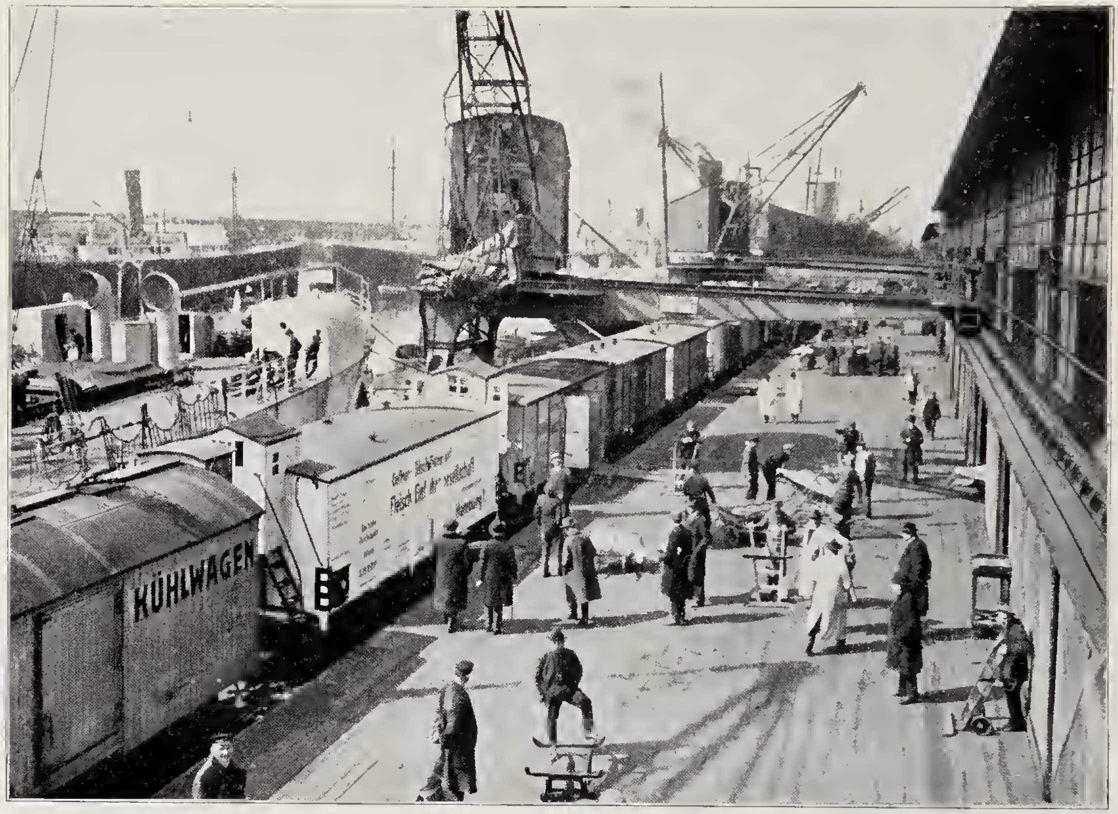


Fig. 13. Platform of Quay Shed No. 73 on Auguste-Victoria-Quai (Cold-Storage Plant for Frozen Meat).

in the fertile alluvial districts near Hamburg are offered for sale in the three market halls and on the wide pavement in front of them.

Another quay shed possessing special equipment is Shed No. 73 on Auguste-Viktoria-Quai (Kaiser-Wilhelm-Hafen). (Fig. 13). It is provided with facilities for refrigeration purposes and is used in connection with the frozen-meat trade. Behind it, adjacent to Shed No. 69 (Grevenhofufer), there is a cold-storage warehouse. A big cold-storage warehouse for eggs has recently been completed. It forms part of a new shed (Shed No. 85) built on Rossquai (Fig. 53). A cold-storage building for fish has been erected close to the Fischhalle on the cityward bank of the Elbe at St. Pauli, and preparations are being made for transforming Shed No. 16 on Hübenerquai (Grasbrookhafen) into a cold-storage warehouse for herrings. In the city itself three cold-storage buildings of considerable size have been provided.

Only a few kinds of combustibles and explosives are allowed to be loaded and discharged at the places ordinarily used for these purposes, and their admission to them is subject to certain regulations. Most articles of this kind, however, more especially oils having a low flash point, must be taken to Petroleumhafen on Waltershof island where the area between the harbour basin and the open river is set apart for their storage and transhipment. Oils which, like petroleum and petrol, have a particularly low flash point, are accommodated apart from the others. The tanks are arranged in groups and each group is surrounded by earth mounds. Protection against the outbreak of fire has been effected by the provision of irrigation plant, degassing installations, numerous lighting conductors, and unoccupied sites surrounding the storage places. A fire brigade station is always prepared for prompt action whenever the necessity arises. The discharge of the tank steamers and the loading of the tank lighters and tank trucks is brought about by means of a complicated system of pipelines through which the oil is pumped. The sites adjoining the basin have been leased to some of the leading oil companies. A separate small harbour basin for explosives has been provided on Prussian territory (Kleine Kattwik) on the left bank of the *Süderelbe* near the spot where the *Alte Süderelbe* branches off from it.

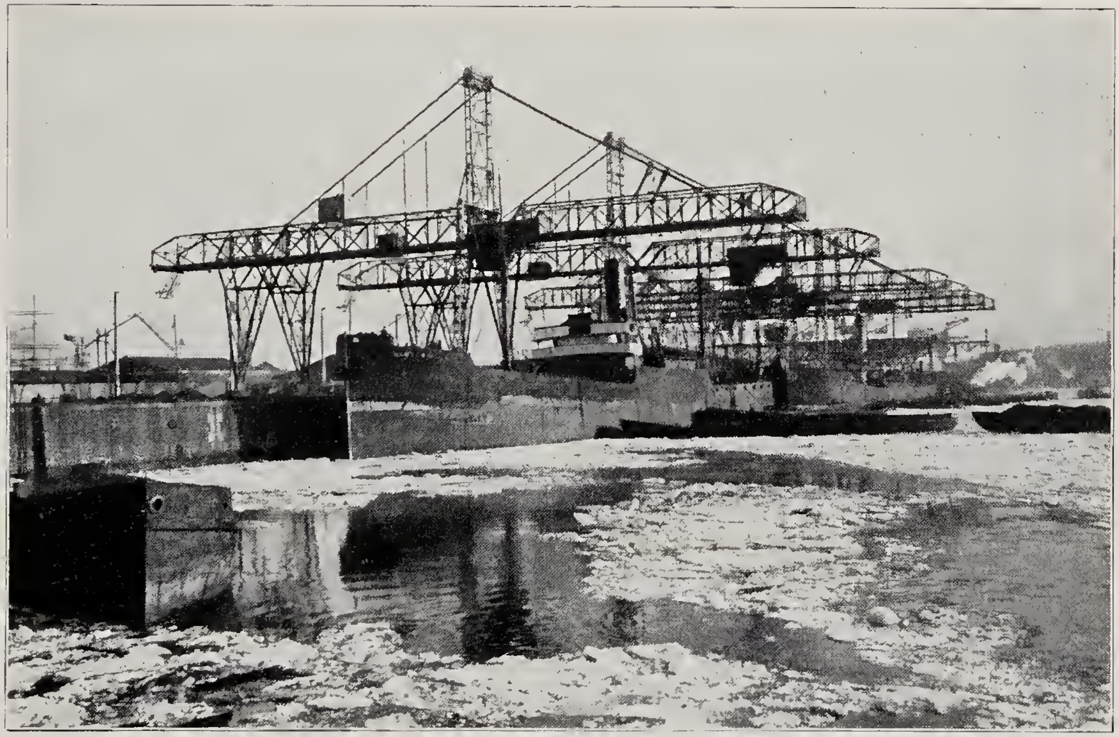


Fig. 14. Loading Bridges in Kohlenschiffhafen.

Numerous special facilities are required for the unloading of coal, the chief article imported. British coal reaches the harbour by sea-going vessels and Continental coal by rail. By far the greater part of British coal is discharged in Kohlenschiffhafen whose east bank is equipped with twelve electric loading platforms (Figs. 14, 35) operated by two private concerns, viz., the

Neue Kohlenheber-Gesellschaft and the Kohlen-Stauereigesellschaft. The coal is either stored on the spot, or discharged into lighters or coal trucks. Floating coal elevators operating in the centre of the wide basin, and occasionally also elsewhere, convey the coal direct from the sea-going colliers into coal barges or other craft. Small harbour vessels supply ocean-going vessels with bunker coal at their berths. It is not the custom in the Port of Hamburg to supply ships with bunker coal from the shore. The use of floating elevators, of course, is not restricted to definite localities, but is resorted to wherever suitable conditions exist. As a rule, therefore, vessels loading and discharging at the quays receive their bunker coal from the waterside whilst doing so.

Special coaling quays have been provided in various parts of the harbour for unloading coal trains from the interior. Sea-going vessels, barges, and harbour vessels are loaded with the aid of electric wagon tipping devices or cranes fitted with buckets and grabs. Two of these coaling quays are located in the Free Port. The older one used by the Hamburg-Amerika Linie is equipped with two wagon tipping devices and 3 cranes and is situated west of Ellerholzschleusen, whereas the newer one is provided with one swing wagon tipping device (Fig. 34) and two cranes and occupies a site near the eastern end of Kirchenpauerquai between the distributing shed near the Elbe bridges and Shed No. 33. Harbourcraft and barges are loaded at the coaling station near the eastern end of the Hofe Canal in the Peute district which is likewise equipped with several cranes and a wagon tipping device of latest design

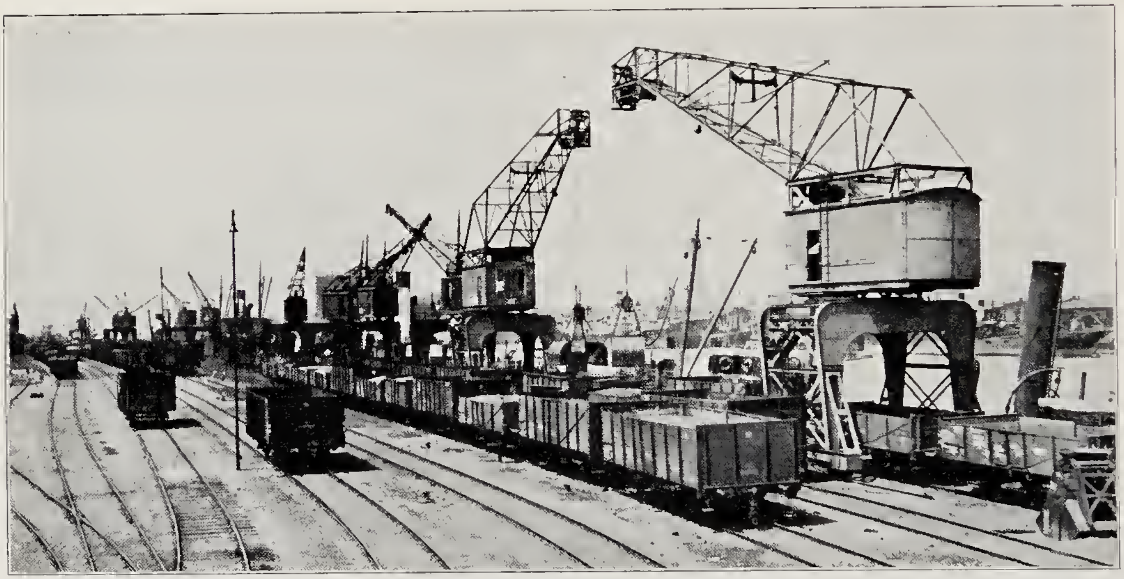


Fig. 15. Holthusenkai shewing method of Direct Transhipment from Ship to Rail and *vice versa. ("Freiladekai")*.

specially suitable for the needs of river transportation. Finally, there is a hydraulic coal tip of older design on Bahnhof III, Oberhafencanal.

When all these special facilities for the transhipment of coal from the vessel to the railroad or *vice versa* are insufficient to cope with the demands, the so-called *Freiladekais*, suitable for handling any kind of bulk goods, are used to supplement them, especially that on Holthusenkai where several modern 5-ton automatic grab cranes are available (Fig. 15).

Some of the private coal depôts located in various parts of the harbour are also equipped with coal discharging devices of considerable capacity, the largest being that on Reiherstieg (Anthracitwerke Gustav Schulze G.m.b.H.). Coal intended to be used by cokeries or gasworks is discharged from the sea-going colliers direct at the works above referred to.

The timber trade is chiefly concentrated in and near Billwärder Bucht, the upper portion of which, the so-called timber dock *(Holzhafen)*, accommodates the rafts upon their arrival there. Most of the foreign timber discharged from sea-going vessels on the quays is stored in yards situated near Billwärder Bucht and Moorflether Kanal, those of Messrs. J. F. Müller & Sohn being especially important. Another large storage place for foreign timber is that of Messrs. Nathan, Philipp & Co. in the Free Port area. Several discharging places have been set aside for timber arriving by river vessels, such transhipment taking place for the most part in connection with a low-level loading road on the cityward embankment of Zollcanal.

Fresh fish intended for inland sale are despatched from Cuxhaven direct, where very considerable harbour facilities are provided for this trade. The corresponding Hamburg facilities, therefore, are mainly intended to serve the local requirements of the city and her immediate surroundings. They include the St. Pauli Fischhalle near the Altona boundary and the premises connected with it, e. g., the above-mentioned cold-storage building for fish which, like the former premises, adjoins the water's edge. Berths for a large number of fishing vessels are available near the landing stages and the quay walls.

Several electric power stations supply the harbour area with the current required for working the numerous cranes and other mechanical appliances, and for lighting purposes. Every quay shed, for instance, is lighted by electric glow lamps. The current, however, is now no longer generated by these power stations themselves, but by others located outside the harbour area. The three-phase current of high voltage generated there is transformed by the harbour power stations into 550 or 440-volt continuous current and is used for crane operation. Continuous current has until now also been used for the electric light supply, but 220-volt three-phase current is to take its place in future. One of the harbour power stations is located in the warehouse town at the rear of Sandthorquai and serves the needs of the Freihafen-Lagerhaus-Gesellschaft, whilst the others are on O'Swaldquai between Sheds Nos. 44 and 45, near the southern entrance to the Elbe tunnel on the Steinwärder side, and in the Kaiser-Wilhelm-Hafen district adjoining Shed No. 73.

A large part of the overseas passenger traffic handled by the Hamburg shipping companies is concentrated at Cuxhaven where special equipment is available for its smooth and expeditious operation. In Hamburg itself, all the steamers not calling at Cuxhaven embark and disembark their passengers at the places where they load and discharge their cargoes, except that some of the companies use the St. Pauli Landing Stages for this purpose, and that the Hamburg-Amerika Linie, the largest of the Hamburg steamship companies, has placed special passenger halls *(Passagierhallen)* at their disposal. They are located on Grosser Grasbrook near Shed No. 21 and are easily accessible from all parts of the city. There incoming passengers are landed and outgoing passengers are transferred to their respective ships by small tenders. Other companies may also make use of these halls if and when they require them.

The company just mentioned has also paid particular attention to emigrant traffic. Its emigrants' home *(Überseeheim)* west of Müggenburger Zollhafen is a small village in itself, and has its own rail connection. It contains ample and comfortable dwelling accommodation, a medical centre equipped with sanitary accessories, churches and chapels for all denominations, and everything else adapted to render the stay of emigrants as pleasant as possible (Fig. 16).

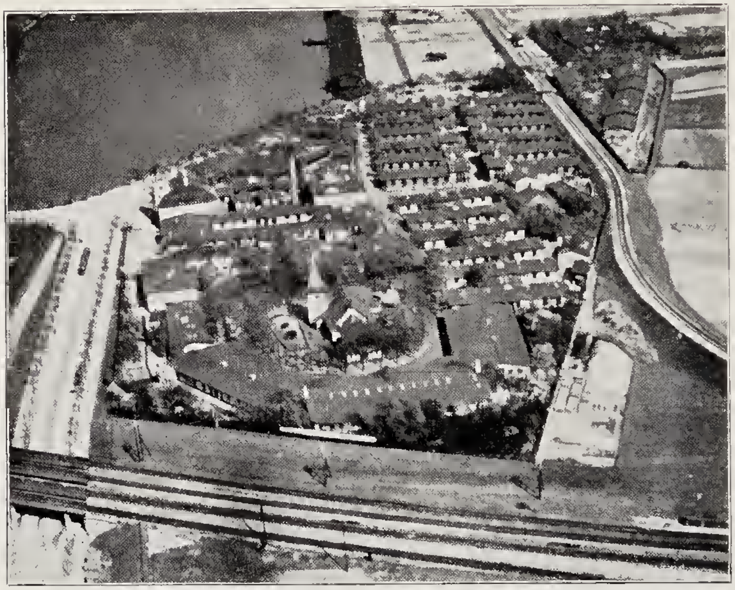


Fig. 16. The "Überseeheim" of the Hamburg-Amerika Linie, Veddel.

Finally, brief mention must be made of several facilities connected with the health and general safety of all persons frequenting the port. A special medical officer appointed by the Board of Health *(Gesundheitsbehörde)* supervises all the measures taken in the interest of health. First-aid stations are scattered throughout the harbour area. Persons who have met with a serious accident or who are seriously ill are taken to the Harbour Hospital *(Hafenkrankenhaus)* opposite St. Pauli Landing Stages. Every vessel is subjected to strict medical control. Patients suffering from tropical diseases are treated at the Institution for Ships' and Tropical Diseases *(Institut- für Schiffs- und Tropenkrankheiten)* which is well-known to medical men all over the world for its efficiency. It occupies a site on the elevated bank of the river at St. Pauli, and its equipment, etc., is first-class throughout. The building itself is a particularly fine example of modern architecture.

A special service has been set up for the disinfection of barges and sea-going vessels suspected of having any disease on board, except those already detained at Cuxhaven by order of the local quarantine authorities. Regulations have also been issued concerning the destruction of rats by fumigation, these rodents being well-known carriers of infectious diseases. The harbour disinfecting station at Veddelhöft has now been replaced by a new one on the dam separating Travehafen from Ellerholzkanal. The gas is admitted to the ship's holds either from the station direct, or from a steamer specially equipped for this purpose.

All foodstuffs and plants imported by the sea route are subject to permanent control. The Food Control Department *(Abteilung für Nahrungsmitteluntersuchung)* of the Hygienisches Staatsinstitut possesses a special control station in the Free Port equipped for such purposes. The chemical investigation of imported meat, fat, and wine, and the general control of imported foodstuffs, take place on the premises of this department at Kuhwärder (near Shed No. 74), whereas the official examination of all plants and fruit imported by the sea route — with a view to detecting any insect pests that might be transmitted by them — is carried out by the Government Institution for Applied Botany *(Staatliches Institut für angewandte Botanik)* in Fruit Shed B on Versmannquai.

Special attention has also been paid by the authorities to the adequate supply of pure drinking water. It goes without saying that every building in the port is connected with the mains, but, in addition to that, numerous taps have been provided, especially in the basins used by rivercraft. Their presence is indicated by large boards displayed very conspicuously and having the words "*Wasser für Schiffer*" painted on them, the intention being to deter masters and crews of up-river barges — many of which are berthed a long way from the nearest inhabited parts — from using the unfiltered Elbe water for drinking purposes. There are also several "water boats" supplying the vessels with pure sub-soil water obtained from an artesian well on Melniker Ufer.

Public houses, for reasons connected with the customs, cannot be permitted in the harbour area. In order, however, to enable workmen and other persons employed there to obtain food and drink at reasonable prices, eating houses *(Kaffeehallen)* distributed evenly throughout the Free Port area have been set up in the principal centres. They are owned by the Government and have been leased to a Government-controlled company which undertakes to sell those articles only on which duty has been paid and to keep its price charges within moderate limits. Some of these eating houses can accommodate up to 1,000 persons, and the food supplied by them is excellent, though plain.

The goods stored in the port represent enormous values. In order to ensure their ample protection and to maintain law and order throughout the whole area, the harbour police service has been very thoroughly organised. Large detachments of police are accommodated in spacious newly erected premises in the Veddel district and on Veddelerdamm, and there are also numerous local harbour police stations from which the security service is organised, so that the owners of goods stored in the port need not feel the least anxiety regarding their safekeeping. Moreover, this highly efficient police service is supplemented by a system of supervision carried out by the interested concerns themselves.

Ample precautions have been taken to reduce to a minimum the risk of fire in the harbour. Every pier is well equipped with fire-extinguishing contrivances and hydrants, and the pier employees as well as those of the big industrial concerns have been trained in their use. The ordinary fire brigade can reach all parts of the port within a minimum of time. In addition to the fire brigade stations serving the municipal districts adjoining the harbour, a special harbour fire brigade station has been provided for the parts on the left bank of the river. It is centrally situated on Reiherdamm between the Reiherstieg bridges and Kaiser-Wilhelm-Hafen and its automobiles and engines are always ready to proceed to any spot within the district at a moment's notice. It has already been stated that the Waltershof area — which has no land connection with the rest of the harbour — has a fire brigade station of its own near Petroleumhafen. Similar provision has been made for the warehouse town. In many cases the best way of extinguishing a fire in the harbour is to approach it from the water side, and this, indeed, is the only possibility available if the endangered vessels are berthed in midstream. For this reason sixteen of the ferry boats referred to elsewhere have been equipped with fire-extinguishing devices, and the Hafen-Dampfschiffahrts-Gesellschaft places them at the immediate disposal of the fire brigade authorities whenever they need them. In a subsequent section of this book it will be shewn that, in addition to the facilities just enumerated, the design of all buildings in the harbour is such as to diminish the risk of fire as much as possible. All these precautions have been further supplemented by the exceedingly strict regulations governing the handling of combustibles, etc., and by the absolute prohibition of smoking.

The navigation of sea-going vessels within the harbour is attended to by a special harbour pilotage service not connected with the deep-sea and river pilots' associations. The pilot station is located at Seemannshöft near the lower entrance to the port and at the western extremity of Waltershof. From there the harbour pilot can easily watch the approach of an incoming vessel and board her in order to relieve the river pilot. The station building is very conspicuous on account of its clock tower, and is well known to every seaman as the first landmark of the Port of Hamburg.

In conclusion, a few remarks must be added concerning the facilities provided for the time-signalling service. They consist in a time ball and two light signals, and are automatically regulated by the Hamburg Observatory *(Sternwarte)* at Bergedorf. The time ball occupies a very conspicuous position above the tall tower of the Kaiserspeicher in Schiffbauerhafen (Fig. 59). It is dropped at 12 noon and 1 p. m. and thus indicates the exact time twice daily. The same purpose is served at night-time by two electric light signals placed on the clock tower of St. Pauli Landing Stages (Fig. 9) and on the tower of the Kuhwärder power station respectively. These signals are extinguished at 6 a. m., at noon, at 6 p. m., and at midnight after being lit up five minutes earlier.

The preceding survey of the Port of Hamburg, its subdivisions, and its facilities for various purposes must suffice to give the reader a rough idea of its general character. The succeeding section will contain a more detailed account of its technical equipment.

SECTION THREE.

Harbour Works and their Mechanical Equipment.

The following chapters will contain brief descriptions of the most important and most notable structures in the Port of Hamburg with some details concerning their mechanical equipment.

The quay installations will be described first, because they constitute, as it were, the principal centre of all port activities.

★

The Quays. Generally speaking, the fundamental design at the bottom of all quay installations in the Port of Hamburg is the same throughout its various parts. Fig. 17 shews a cross section through one half of the narrow peninsulas equipped with quays on both sides as they are built at present. A solid quay wall separates the land from the water. It rises almost perpendicularly, and its outline is adapted to the shape of a ship's hull. As the original level of the land was everywhere well below that reached by the highest tides, it had to be raised by artificial means, with the result that the surface of the land in the modern sections of the harbour area lies practically everywhere 30 ft above Hamburg zero, i. e., about 13 ft above M. H. W. (+ 17 ft) and about 20 ft above M. L. W. (+ 10 ft).[1] So high a level was required, in the first place, as a precaution against the tides. The highest tide on record (1825) brought the water up to + 28 ft 6 ins. Since then it has only risen seven times above eight metres (26 ft), the figures ranging between + 26 ft 6 ins and + 28 ft 4 ins. The harbour area may therefore be said to be practically safe from inundations. In the second place, however, the height of the ships' sides had to be taken into account when fixing the level of the shore area and more particularly that of the top edge of the quay walls. This consideration was not very important so long as vessels were comparatively small, and there was therefore no occasion to apply it to the older type of quays which were intended to be used, and are still being used, for the loading and discharging of small ships. Indeed, at the time they were built, the object aimed at was to minimise as much as possible the height of the crane lift. All the cranes then in use were steam cranes, and the height of the lift affected their power consumption to a far larger extent than it does in

---

[1] All statements concerning levels refer to "Hamburg zero" which lies 3.538 metres (11 ft 7 ins) below "standard zero".

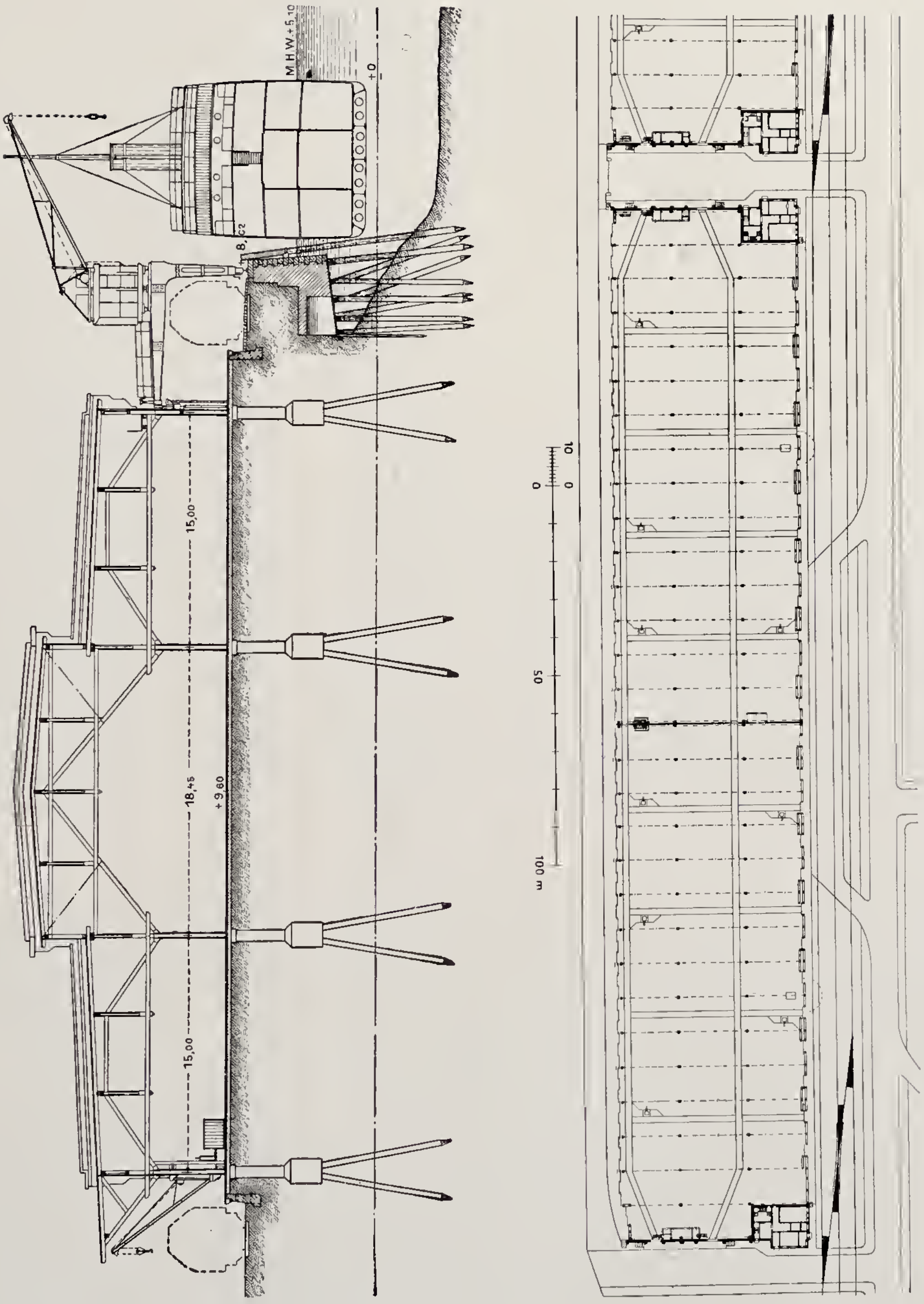


Fig. 17. Section across a Quay Shed with Ground Plan.

the case of the electric cranes employed at present. The level of the land area, therefore, was kept relatively low. The top edge of the older quay walls (+ 26 ft 4 ins) lies well below the level reached by the highest tides, but there is nevertheless no danger of the commodities stored on the quays being exposed to the water, because the level of the quay shed floors and that of their front and rear platforms exceeds the height of the roadways by an amount equal to the height of the cart or railroad-truck platforms (about 4 ft), so that there, too, a minimum level of 30 ft can be relied on.

The provision of raised platforms on both sides of the covered sheds permits the rapid loading and unloading of carts and railroad trucks on the water as well as on the land side. Thus, the utmost freedom is secured in regard to the handling of the cargo. The material used for levelling-up the sites occupied by the transit sheds consists, for the most part, of dredged sand. In the case of the latest type of sheds the average width of the floor measured between the outer edges of the loading and unloading platform extensions is about 180 ft, and in some sheds as much as 200 ft. Between the water's edge and the front platforms of the sheds there is a paved road, from 23 to 30 ft wide, provided with one or two railroad tracks. The gantries of the electric cranes span the road and the shed platforms, so that the entire width of the former is available for the handling of the cargo. As a rule, three railroad tracks of a combined width of 43 ft are laid on the approach road that runs along them iddle of the quay peninsula throughout its length. The width of this road including the footpaths lining it is about 40 ft. The quay facilities on both sides of it are arranged more or less symmetrically. Generally speaking, the total width of the peninsulas ranges between 530 and 600 ft, the exact figure in each case depending on the state of development reached by the type of basin concerned.

*

The Quay Walls.

The first detail that claims our attention in connection with the description of the quays is the quay wall (Fig. 18). It stands to reason that the constantly increasing depth of the harbour basins has necessitated numerous changes in the design of the quay walls as regards their measurements, the material used for their construction, the methods of their foundation, etc. Originally, the body of masonry behind the breast wall consisted of piers and vaults, but when it was found that the mass of material that has to withstand the ever-varying pressure due to the movement of ships could not be too large, the former system was abandoned, so that all the later types of quay walls consist of solid masonry throughout. For the same reason no use has been made so far of reinforced concrete, at least not in connection with quays from which ocean-going vessels are despatched. Only the quay walls of three canals with barge depth, viz., Rosskanal, Hofe-Canal, and Grenzcanal, are faced with this material.

The first quay wall still extant was built in 1868. The oldest quay walls consist of brickwork with clinker facings (cf. Sandthorhafen, Grasbrookhafen, Strandhafen, and Magdeburger Hafen). Between 1884 and the early years of the present century, sandstone was used for the facings (cf. Baakenhafen, Kirchenpauerquai, Segelschiffhafen, Indiahafen, Hansahafen). All quay walls, however, built since then, are made of concrete of cement and pebble stone with basalt facings. At first, the foundations on which the body of masonry rests consisted of sunk wells made of brickwork (cf. Kaiserquai, Dalmannquai, Magdeburger Quai), but since about 1880 wooden pile foundation grills have been used instead (Fig. 18). The latter method was not only found to be less expensive, but also better adapted to the special conditions of the soil. The top surface of the layer of sand which formed the original bed of the Elbe and which was subsequently covered by layers of peat and clay of various thicknesses is situated at various depths (ranging between + 4 ft 7 ins and — 18 ft), but as this layer is the one by which the whole structure has to be supported, it is also that which has to be reached by the parts that form the foundation of the walling. The piles are driven into the sand to a depth of 10 to 13 ft, and their length can always be fixed in accordance with the condition of the soil at each particular spot, so that the quantity of the material used can be kept within economic limits. It is understood, of course, that their tops lie below the bed of the water spaces in the harbour.

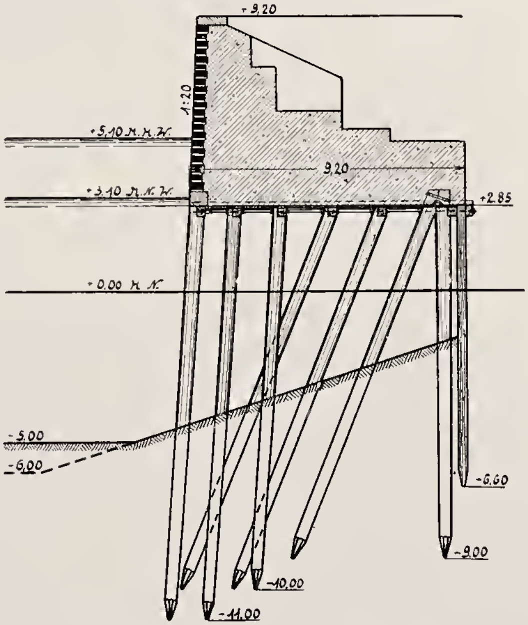


Fig. 18. Cross Section of a Quay Wall.

The upper limit of the wooden foundation, i. e., the height of the plank covering placed on the horizontal grillage supported by the pile structure, is determined by the depth down to which the wood is liable to rot. This means that it lies about 3 feet above low water, at which level the wood is exposed to contact with the air for short periods only, so that it cannot become dry and cannot rot. It has nevertheless been thought advisable to keep the woodwork as much as possible even below the limit thus fixed. Here we must make a distinction between quay walls built in enclosed foundation pits and those built in open water the level of which is subject to the rise and fall of the tides. In the former case the depth at which the wood construction ends and the masonry begins is generally fixed at + 9 ft 4 ins, and in the latter case at + 11 ft 10 ins.

The continuation of the structure separating the water and the soil below the masonry is formed by a wooden wall. As a rule, it lies in the rear of the quay walls, although in some cases the front is also provided with it as a protection of the foundation piles against damage through ice. The walls in question consist of grooved and tongued planks, or — where a thickness exceeding 10 ins is required — of square piles placed together as closely as possible. The maximum thickness of the wall is about one foot, and its height between the masonry and the soil is always limited by the amount of pressure exerted by the latter. It follows that the thicknses of the masonry level with the horizontal grill is proportionate to the depth of the harbour basins, and is greatest in the deepest and most modern ones. It has increased from 12 ft to 30 ft whilst the depth of the basins at low water has increased from 20 to 33 ft, and permits the rows of piles underneath the masonry to be arranged as conveniently as possible.

The walling referred to is supported by trusses consisting of two piles each which are rigidly joined by a wedge and an iron ring and which enter the body of concrete. The object of the trusses is to absorb the greater portion of the pressure of the soil against the wall. In front of them there are, in the case of the modern-type of walls, five rows of piles arranged lengthwise which support the horizontal grillage. The average diameter of these piles is from one foot to one foot three inches, and their slope is either 15 : 1 or 2.5 : 1. Some of them have had to be driven into the river bed as much as 36 ft below Hamburg zero, and emerge to a height of 12 ft above it, so that their length is about 53 ft. The approximate number of foundation piles supporting the quay walls has been estimated at 200,000, and it would therefore require an area of about 1,200 acres, i. e., the area of the island of Waltershof, to provide the necessary timber. This estimate, of course, does not pay regard to the number of 25,000 piles required for dolphins, of which there are about 8,900 in the harbour area.

The total height of the quay walls, including the foundation piling, is about 66 ft, which is equivalent to that of an ordinary five-storied apartment house.

The body of masonry tapers in an upward direction in proportion as the pressure of the soil behind it diminishes.The upper and lower edges of its frontage consist of granite slabs, whilst the remaining part of the front surface is faced with basalt columns whose thickness ranges between 10 and 14 inches. At intervals varying between 120 and 160 ft, the entire body of masonry is intersected by joints intended to prevent cracks and to absorb dangerous stresses that might asise through changes in the temperature.

The quay walls would but imperfectly fulfil their purpose of enabling ships to load and unload their cargoes if they were not fitted with special mooring equipment (Fig. 77). Cast-steel mooring palls and rings for the use of sea-going vessels are provided at distances of no less than 80 ft, and chains for the use of smaller craft at distances of no less than 26 ft. Guarding piles and guarding beams arranged at distances of about 30 ft protect vessels from being damaged when rising and falling with the incoming or outgoing tide, whilst ladders provided at distances of about 160 ft give direct access to the quay walls from vessels berthed there. Where the mooring palls are attached to the masonry, the latter has been adequately strengthened. In order to prevent water from accumulating behind the walls, drain pipes are laid throughout the masonry at distances of about 40 ft.

The above description applies more particularly to quay walls facing basins for sea-going vessels, but most of the details given also hold good for those facing basins with barge depth, except that in this case the construction is less massive. The total length of quayage in the Port of Hamburg is 30 miles, or half the distance from Hamburg to Cuxhaven, the details being:

Quay walls facing deep-water basins 20 miles,
Quay walls facing basins with barge depth 10 miles.

★

The Quay Sheds.

The quay walls enable vessels to take up their positions within reach of the cranes on shore there to be loaded or discharged. It does not often happen that the merchandise is directly transferred from the land carrier to the ship or *vice versa*. The rule is that it is taken to a covered and sheltered place sometime before it is stowed away on board or after it has been discharged, as the case may be, and that it is retained there for a short space of time. This purpose is served by the quay sheds. It is of very great importance that their design and equipment should satisfy every reasonable requirement, because the safety and punctuality of all quay operations largely depend on it. The present chapter is intended to give a fairly detailed account of the modern type of quay or transit sheds as they are in existence in the Port of Hamburg (Fig. 17).

Their principal feature is that they consist of one single room only, and that they possess no upper floors. These characteristics have been strictly adhered to in spite of the reiterated suggestion that some other type should be tried. There is, however, one exception to the general rule, viz., Fruit Shed C in Magdeburger Hafen, which, on account of the special circumstances of the fruit trade, has been provided with an upper floor.

The principle of restricting the accommodation to one single room whose floor is level with the platforms of the railroad trucks is based on the following considerations: It is not intended that merchandise should be stored in the sheds for any prolonged period of time. Goods to be loaded are only to arrive a few days prior to the sailing date of the ship, and discharged cargoes are only to remain there until they are taken possession of by the consignees. All that is needed, therefore, is to provide so much space per ship's length as will comfortably hold a full ship's load of cargo. Experience has shown that in the case of the biggest vessels a width of 160 feet is sufficient for this purpose. The construction of sheds of such width presents no technical difficulties, and the expenditure required does not make them unremunerative. The argument that the addition of an upper floor would permit a reduction of the necessary width by fifty per cent, is not valid, because the supporting capacity of the second floor would have to be much less than that of the ground floor. The latter rests directly on the solid earth, and the goods deposited there do not exercise any pressure on any specially provided supports, so that its supporting capacity is unlimited. In practice, indeed, loads of 8 tons per square yard are nothing unusual. An upper floor, however, could scarcely support more than 2 tons per square yard, no matter how strongly it were designed, and would also require more massive foundations. Thus the gain would be slight, but the additional expense and the resulting drawbacks would be very considerable. The latter would be such as to interfere with the smooth handling of the goods. The principal features of an efficient quay shed must be: wide spaces permitting easy access, a minimum number of intervening supports, and a maximum of daylight. Only the single-floor sheds satisfy these requirements. In sheds having an upper floor, numerous supporting posts would have to be provided, and these would obstruct the work carried out on the ground floor. Besides, it would be necessary to use artificial light even in the daytime. Drawbacks such as these would be too high a price to pay for the advantages derived from diminishing the width of the sheds.

The foregoing considerations have given rise to the creation of the type of quay shed that is found in the Port of Hamburg (Fig. 17). The measurements given below are those of Shed No. 81 on Stettiner Ufer, but those of all the more recently constructed sheds are practically the same. The length of the shed is 1,000 feet, and the width between the front and back walls 160 feet. A solid fireproof wall divides it into two halves, called A and B respectively, each of which is 500 feet long. Two rows of supports parallel to the front and back walls divide each half into a central nave (60 feet wide) and two aisles (50 feet wide each). The ceilings of the aisles are lower than that of the nave. The central nave and the front and back walls of the shed afford opportunities for admitting the light sideways, so that the shed is always amply and uniformly lighted (Fig. 19). This feature, as has already been pointed out, is exceedingly important in connection with the work going on the shed, e. g., weighing, sorting, testing, repairing damaged packages, etc. For the same reason a large number of powerful incandescent lamps is provided for work after dark. The wooden floor rests directly on the solid earth and is independent of the supporting posts and their foundations. Truck paths made of sheet iron intersect it in both directions. The roof trusses are about 30 feet apart from one another. These, as well as the entire roof, are constructed entirely of wood, except that the lower parts of the supporting posts are made of iron. They are fixed to the concrete foundations, and these in their turn are founded on pilings. The solid rear wall of each shed has 32 openings — corresponding to the number of trusses — each of which can be closed by a sliding door. Through them the goods can be transferred to the six-foot platform outside the shed and from

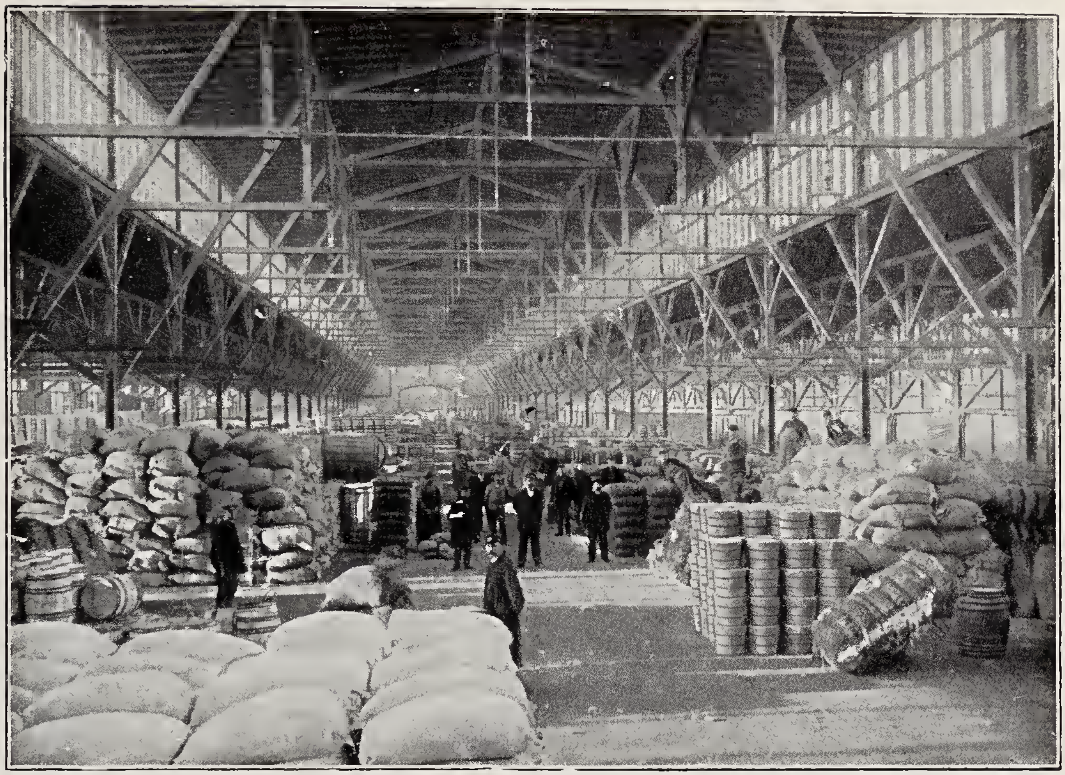


Fig. 19. Interior View of a Quay Shed, showing half the Shed only.

there to the cart or railroad truck. In front of the platform there are three Harbour Railway tracks, connected by sets of points. Part of the road space is paved, so that it may also be used for carts approaching the shed platform. The front or waterside wall of the shed, up to the girder for the crane frames, is entirely made up of sliding doors of corrugated iron which may be slid behind one another in pairs, thus making it possible to provide entrances anywhere. The front platform is really a continuation of the covered floor but without the covering. It has a width of 20 feet, and, like the rear platform, rests on a supporting wall. Between the front platform and the edge of the quay wall there is the 30-feet paved roadway provided with two railroad tracks. The space above the road and the platform is spanned by the semi-portals of the cranes the horizontal beams of which travel on the shed itself as mentioned above, whilst the leg runs on a rail close to the water's edge.

Each quay shed terminates, at one of its two extremities, in a solid building containing offices, workmen's common rooms, dwelling quarters for officials, workshops, etc. (Fig. 65). In front of it there is another platform accessible to carts. A passage running through the whole building connects it with the floor of the shed, so that goods may also leave the latter on that side. Still more convenient, however, is the corresponding arrangement at the opposite end of the shed where the shed platform is the direct continuation of the floor space, except that one corner of the shed directly adjoins a small building, of a width equal to that of one aisle, which is used for management purposes. The passage between two neighbouring sheds is wide enough to enable carts to turn round in it and motor lorries with their trailers to obtain access to the road along the water's edge. The crane rail girders are carried across these passages, and the waterside shed platforms of two neighbouring sheds can also be joined by connecting pieces, so that all the operations involving the use of cranes can be carried out without being hampered in any way.

The covered and lockable floor space of a shed as described above occupies an area of $3^1/_4$ acres. Its length equals that of two sea-going ships, and enables these as well as a few smaller craft to be attended to simultaneously. The length of the railroad tracks connected with it is about 5,000 feet, and that of the roads for vehicular traffic about 1,700 feet. Carts may approach any of the four sides of the shed, subject to the provision that the Railway Company is entitled to preferential treatment as regards the two long sides. The provision of railroad tracks on both these sides permits the separation of goods requiring to be stored in the shed from such as have to be directly transferred from the vessel to the railroad or *vice versa* on account of their weight, bulk, or dangerous character. The two systems of tracks are connected at the pierheads by means of turntables, and on the very long quays, e. g., Petersenquai, Asiaquai, Amerikaquai, and O'Swaldquai, there is an additional connection by means of sets of points between the sheds to facilitate operations. The need for two tracks on the waterside has only arisen in recent years, and most existing quays are provided with only one such track. Some of the earliest quays, indeed, are without any tracks at all on that side. On the other hand, some quays are provided with a larger number of tracks in the rear of the sheds — five being the maximum — for marshalling and shunting purposes.

The following figures illustrate the development of the Hamburg quay sheds as regards their measurements during the sixty years that have passed since the first modern shed was built.

Date of opening	Name of Quay	Width of Sheds in feet	Length of Sheds in feet
1866	Sandthorquai	49	560
1872	Kaiserquai	73	700
1877	Hübenerquai	84	700
1888	Versmannquai	98	730
1898	O'Swaldquai	112	860
1907	Grevenhof-Ufer	138	880
1909	Bremerquai	160	880
1922	Rossquai	160	1,070

The various types of sheds were always able to cope with the maximum needs of traffic at the time they were built, and as the vessels now frequenting the Port of Hamburg range from large sea-going steamers to small coasters, the accommodation meets the requirements of every type of vessel. The earliest and smallest sheds are by no means obsolete. Indeed, owing to their proximity to the business quarters of the city they are particularly popular, and to-day they are just as suitable for the handling of vessels to and from European ports as they were sixty years ago. Some time before the war several of the earliest sheds (e. g., Sheds Nos. 2 and 3 on Sandthorquai were rebuilt, but the only important changes made in their design were the replacement of the open water front by solid walls, and that of the cranes travelling along the quay road by semi-portal or gantry cranes.

Fig. 2 shews the development of the quay sheds in relation to the increasing measurements of ships.

The sheds for special purposes to which reference has already been made elsewhere differ to some extent from the ordinary type as far as their design is concerned. The Export Shed near Magdeburger Hafen, for instance, has a triangular, and the Distributing Shed at the east end of Kirchenpauerquai, a pentagonal ground plan. The last-named shed and the Collecting Shed near Magdeburger Hafen are provided with two railroad tracks within, which was found necessary because there the railway dominates the method of operation. The rectangular ground plan has not been adhered to everywhere, but has been replaced by a different design wherever local conditions made this desirable, e. g., Fruit Sheds A and B, and Sheds Nos. 18 and 19.

The greatest deviation from the normal type, however, is seen in Fruit Shed C, near Magdeburger Hafen, which was completed in 1912 (Fig. 20). It has already been stated elsewhere that this is the only example of a shed used for the despatch of sea-going vessels that has been provided with an upper floor. This provision was made to comply with the requirements of the fruit dealers which it is intended to meet in the first instance. Both floors are used for the discharge of fruit steamers, whose cargoes are without exception transferred to the railroad. The vessels engaged in the fruit-carrying trade do not, of course, receive any return cargo at the same shed, so that we have here an example of a traffic that moves in one direction only. This circumstance greatly facilitates the despatch of the steamers from two floors. The width of the shed is 110 feet. In two-storied sheds having a greater width than this it would be impossible to adequately light the ground floor without having recourse to artificial light. The upper floor is made of reinforced concrete and has a carrying capacity of 2,800 lbs to the square yard. The discharge of the goods on to the upper floor is effected with the aid of a gallery on the waterside and the platforms provided on the travelling crane portals. In the rear there are small balconies from which the goods are transferred to the railroad trucks by means of wall slewing cranes. The upper story is divided into numerous compartments that may be rented separately. Goods are conveyed from one story to the other by means of lifts and spouts. The shed is provided with central heating. The temperature within can be raised to 43 degrees F above

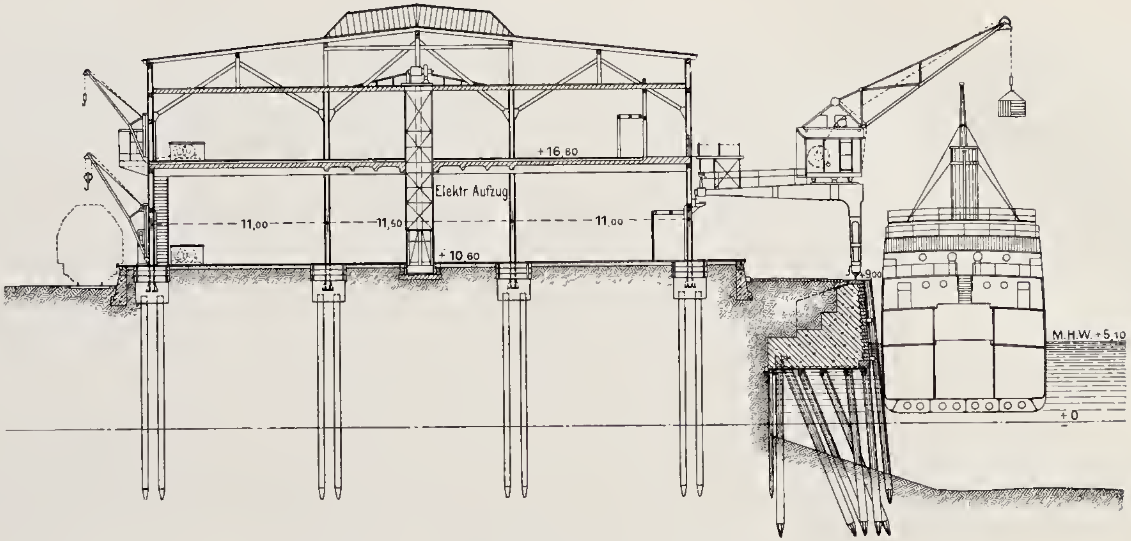


Fig. 20. Cross Section of Fruit Shed "C".

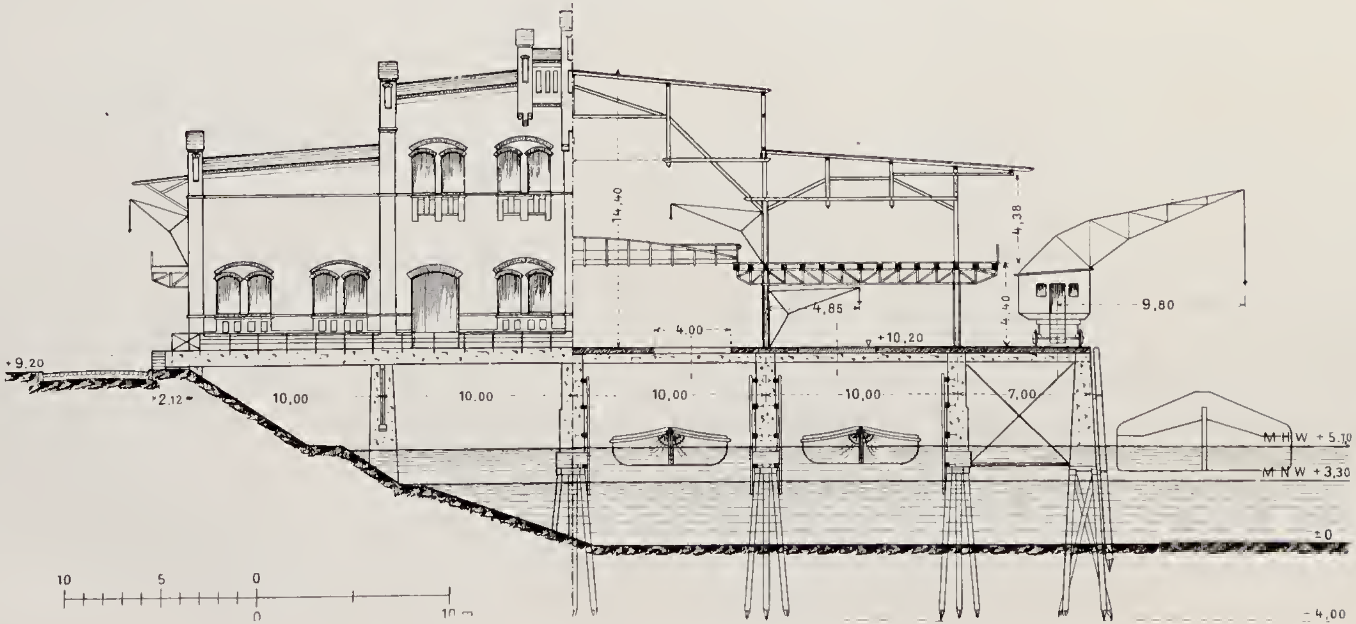


Fig. 21. Cross Section of Shed on Prager Ufer used by Rivercraft.

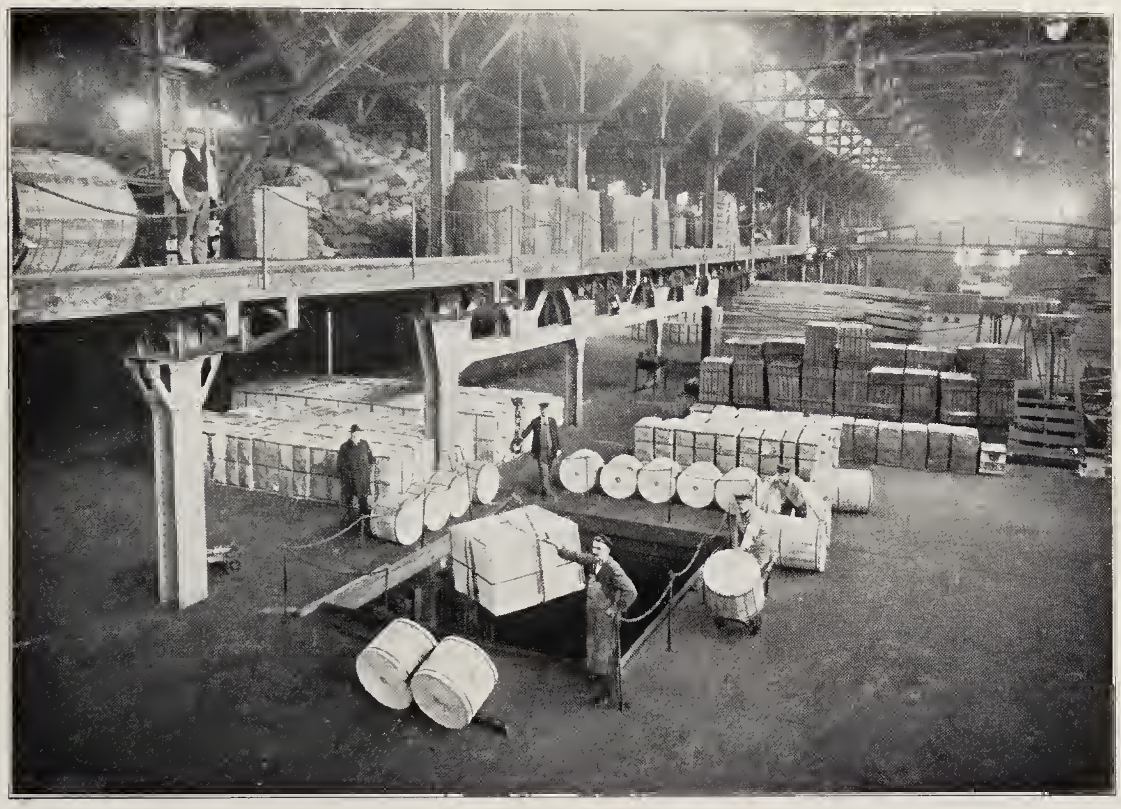


Fig. 22. Interior of Shed on Prager Ufer used by Rivercraft. Transhipment into the lighters accommodated underneath is effected through the openings in the floor.

zero when the outside temperature is 4 degrees F below zero. Double walls with peat-dust insulation and a ceiling containing sky-lights help to guard against the loss of the heat thus obtained. Similar arrangements have been made in the four single-storied fruit sheds situated elsewhere.

Some of the privately owned or privately managed sheds located on water with barge depth are also of the two-storied type. The most important of them is the shed leased by the United Elbe Shipping Companies *(Vereinigte Elbeschiffahrts-Gesellschaften)* on Prager Ufer near Moldauhafen (Figs. 21, 22). In this case, however, the upper story does not cover the whole width of the shed — which is 130 feet — but only the two aisles. The two galleries thus formed are connected by several iron bridges. A special feature of the shed referred to is that it is partly built above the water so that two rows of harbour lighters can be towed underneath where they are loaded and discharged through the hatchways in the floor. The up-river barge cargoes, on the other hand, are handled from the platform on the waterside.

The number of existing quay sheds for the despatch of sea-going vessels is 78. Their total length is 11 miles, and the covered floor space contained by them is 150 acres. If we reckon that 20% of this area is occupied by cart tracks, we find that the useful covered floor space is 120 acres. Assuming that the average weight of the cargoes temporarily stored there is $1^1/_4$ tons per square yard, it follows that 700,000 tons of cargo can be accommodated simultaneously by the quay sheds available in the Port of Hamburg.

★

Quay Equipment.

The principle of combining the utmost possible speed in the handling of the cargo with the provision of every safeguard for its protection against damage, which underlies the design of all the quay sheds, has also been applied to their equipment. Experience has shown that the intelligent use of mechanical devices not only reduces expenditure, and therefore permits the charging of low fees for the various quay operations, but that it also serves to favourably affect the "rhythm" of the work performed. This knowledge has been translated into practice wherever an opportunity presented itself, although the limits of its application have never been lost sight of. Every technical innovation that seems likely to be of use is tested by the port authorities, but none is introduced unless an extended trial period has shewn that it is specifically adapted to the peculiar requirements of the Port of Hamburg. Many a novel device and many a new idea owe their origin to the experience gained by the Hamburg port administration. The first electric harbour crane was built in Hamburg, and the twin crane, the triple crane, and — as far as Europe is concerned — the electric truck as used for quay operation, were first introduced by the Port of Hamburg authorities. The aim of these and similar improvements was to eliminate every avoidable delay in working. Thus, for instance, the speed of the crane work has to be correlated to that of the work going on in the sheds in such a manner as to ensure the maximum benefit from both, and stoppages of work have everywhere been reduced to a minimum. It has thus been possible to gradually increase the efficiency of the work performed per man and per hour. It goes without saying that the output — like that of every big industrial concern — is constantly checked and that statistical records concerning it are carefully kept. The ideal before the authorities is to utilise the available plant to best advantage and to keep abreast of the progress of the times.

Above all, however, Hamburg has never begrudged her port any money when it has been necessary to meet exceptionally heavy demands on it. In Hamburg, as everywhere else, there are frequent occasions when the strain on any particular department is more than usually heavy. The view taken of such occasions is that a very expensive piece of equipment is worth installing even though it may have to be used to its maximum degree of efficiency only on comparatively few occasions. This applies, for instance, to the despatch of mail steamers, which requires the utmost punctuality. The shipping trade is entitled to claim that its interests in this and in other respects should always receive the greatest attention. In fact, the guiding principle underlying the design of the port has been to reduce to a minimum the time vessels are compelled to stay in the harbour in order to enable them to be utilised as much as possible for their primary purpose, i. e., the carrying of merchandise and passengers.

★

The Cranes.

We propose to start our description of the quay equipment with that of the cranes used in the harbour. Steam cranes have been entirely abolished, because owing to their clumsiness and unremunerativeness they are looked upon as obsolete. Another typical feature is that the distances at which the cranes — which are practically without exception driven by electricity — are placed from one another are so short as is probably the case in no other seaport anywhere. Finally, the efficiency of the transhipment work has been raised to the highest possible degree by increasing the lifting capacity of the quay cranes to 5 tons and by furnishing single crane frames with two, and — in the case of the very latest cranes — even with three crane hooks.

It is interesting to observe the successive stages in the development of the Hamburg quay crane system and the manner in which it has from time to time been adjusted to the increasing demands on it in accordance with the progress of technical science.

The first mechanically driven quay cranes in the Port of Hamburg were introduced when the first quay, viz., Sandthorquai, was opened to traffic in 1866. They were travelling steam cranes moved by hand along the railroad tracks on the waterside roadways. They carried their own boilers and had a lifting capacity of $1^1/_2$ to $2^1/_2$ tons. Their steam engines acted upon a rope windlass. They were, however, soon replaced by a different type designed by Messrs. Brown, Wilson & Co., of London, whose principal feature was that the steam from the cylinder piston acted directly upon a pulley block. These cranes constituted a considerable improvement upon the older type, and continued to be in use until a few years ago when electricity began to be introduced more generally in connection with quay operations. More than 300 such cranes were used, some of which attained a life of more than 50 years. Since the nineties of the past century, however, no additional cranes of this type have been installed, because they were found to suffer from two drawbacks. In the first place, they occupied about 10 feet of the width of the roadway — a space that could be much better used for vehicular traffic, and in the second place the system of heating their boilers separately was found to be unremunerative. When, therefore, Petersenquai (Baakenhafen) and Asiaquai (Segelschiffhafen) were built in 1890/91, these two quays were equipped with steam cranes of the semi-portal type which would not interfere with the road traffic

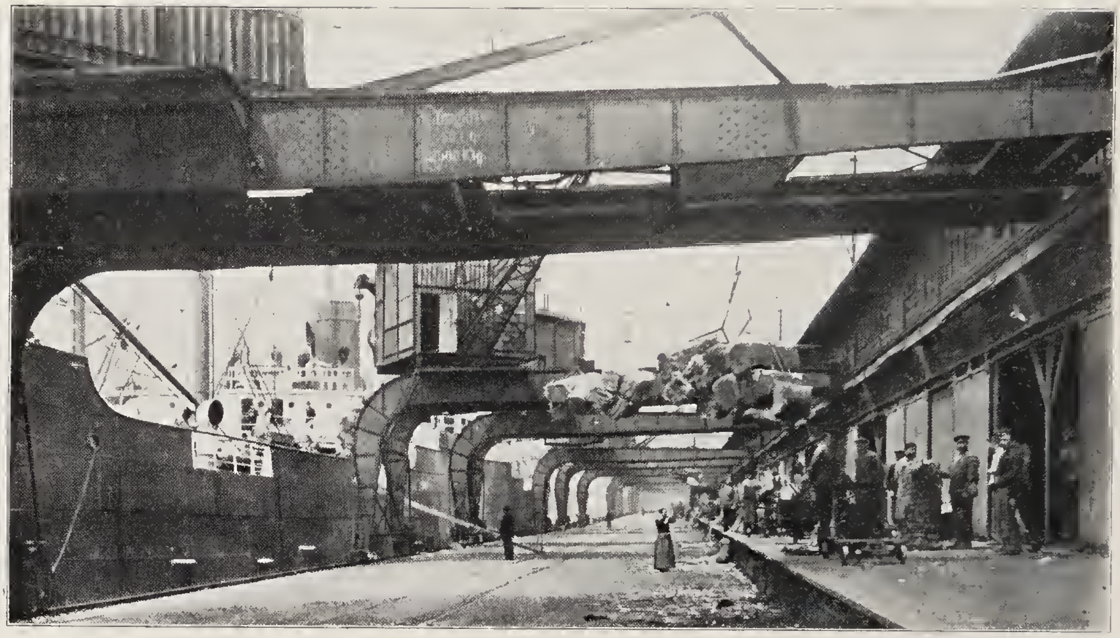


Fig. 23. Asiaquai, Segelschiffhafen.

(Fig. 23). Central boiler plants, from which the steam was conveyed to the cylinders of the crane engines by thoroughly insulated pipes closely adhering to the cranes were established at the same time. These were regarded as a great advance when they were introduced, but they, too, have subsequently been replaced by electrically driven cranes. Their lifting capacity was $2^1/_2$ tons.

The system of steam supply just described was modelled on the principle of the hydraulic drive. Owing, however, to topographical and climatic conditions, the latter method has scarcely been introduced at all in connection with quay operations in the Port of Hamburg. The only instance is furnished by the Collecting Shed *(Sammelschuppen)* near Magdeburger Hafen. But its replacement by electric drive is merely a question of time, and has already been decided upon in conjunction with other alterations. The fact that the winches with which the large warehouses of the Freihafen-Lagerhaus-Gesellschaft are equipped are hydraulically driven, and that this system has been found eminently satisfactory, proves that the advantages of the hydraulic drive are by no means underrated in Hamburg. The methods of operation, however, adhered to in warehouses are altogether different from those employed in crane work.

Simultaneously with the introduction of the semi-portal cranes on Petersenquai (1891) above referred to, the first experiments with electrically driven cranes were made on the same quay. Their very considerable advantages, e. g., their immediate availability at any moment, their greater remunerativeness, and the simplicity of operating them, were evident at once, but since,

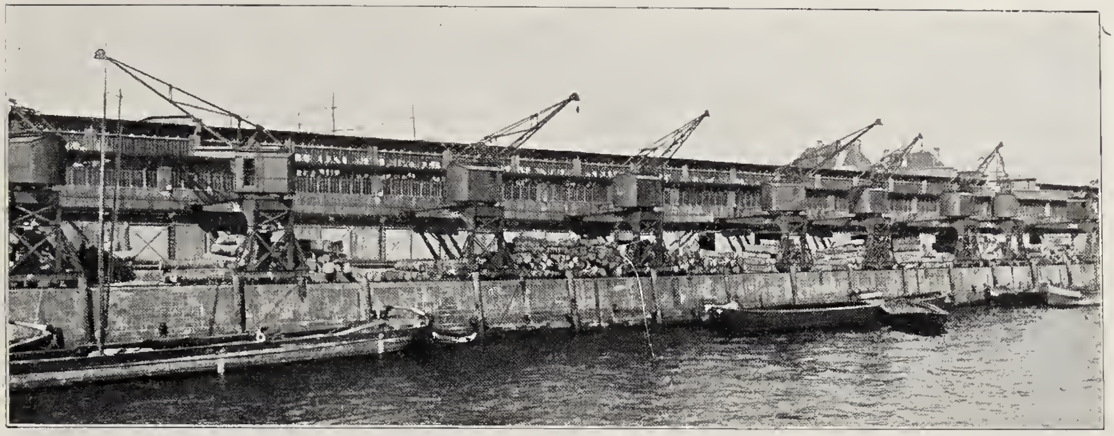


Fig. 24. A Cargo of Timber discharged on the Quay (shewing three-ton Cranes of the usual type and Water Frontage of Quay Sheds).

in their earliest types, they were also found to have certain drawbacks, it was decided to postpone their general introduction until the necessary improvements had been designed. It was therefore necessary first to develop the type of crane motor that would be suitable for intermittent operation. This task was practically accomplished when the shunt motor was replaced by the series motor whose radius of action and whose power consumption are always directly proportionate to the load. Since 1898 electrically driven cranes have been exclusively entered into the service (Fig. 24). Efforts to still further improve the present type have never ceased, and nearly all the cranes installed in connection with new quay sheds deviate in some small detail from their predecessors. After all, the satisfactory operation of pier facilities depends very largely upon the efficiency of the cranes.

In spite, however, of such small differences, the chief features of the modern

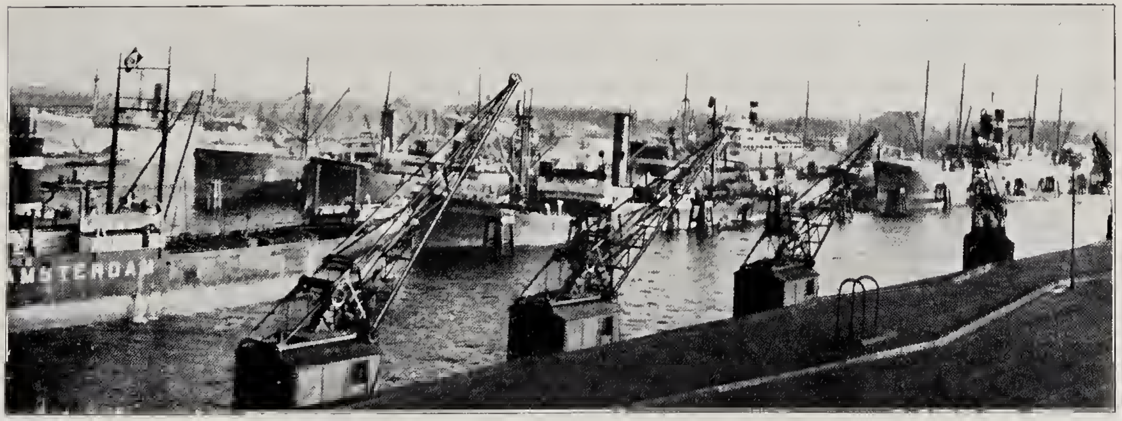


Fig. 25. Cranes with Adjustable Jibs.

Hamburg type of crane have substantially remained unaltered during the past fifteen years or so. Such relative uniformity is a great advantage from the point of view of pier operation. It could only be achieved by giving all orders for new cranes to a few selected firms, and their number has been constantly reduced until practically all these orders are now given to Messrs. Eisenwerk, vorm. Nagel & Kaemp A.-G. *("Kampnagel")* who have supplied the Port of Hamburg authorities with nearly 800 cranes.

The principal features of the standard type of pier crane as at present developed may be seen from the following description. The slewing crane whose mechanical parts are accommodated in an iron crane cabin is supported by a gantry (semi-portal) about 16 feet high. The length of the horizontal arm of the latter ranges between 25 and 44 feet, according to the width of the roadway and the shed platform. The slewing crane has a handling radius varying from 34 to 37 feet. The angle of the jib may be altered by an electrically operated device (Fig. 25) in such a way that the handling radius of the unloaded crane can be varied between 25 and 37 feet. The carrying capacity is 3 tons, the lifting speed of crane when fully loaded is from 2 ft to 2 ft 4 ins. a second, and the slewing speed is 6 feet a second. The lifting motor used is a series motor indicating 26 H. P. at a speed of 400 revolutions a minute. The slewing movement is brought about independently by a separate motor. The lifting movement is regulated by a hand-lever brake, and the slewing movement by a foot-lever brake. The control mechanism is of the simplest kind. Slewing, lifting, and lowering are all controlled by a single manipulation, all movements taking place in the same direction as those of the crane hook. An automatic disengaging gear prevents the crane from being excessively loaded and thus ensures the maximum stability obtainable. The movements entailed by the adjustment of the crane to its exact position in relation to the ship's hatch are effected by an electric motor. The travelling speed is 4 inches a second. The current used is continuous current of 550 volts (440 volts at Kuhwärder).

Wherever the design of the sheds does not permit the use of gantries, electrically driven roller cranes are installed as substitutes for the older type of steam roller cranes (Fig. 77). Their general design corresponds to the type just described.

With the exception of two quays where overhead loop lines are used, the current supply of the roller cranes is obtained by means of underground lines, and the distribution from the main cable is brought about by earth junction boxes and flexible connecting cables. In the case of the gantry cranes, cable connection with junction boxes fixed to the walls of the sheds was formerly the rule. Since the general introduction of the electric traversing gear this method has been replaced by the use of loop lines in front of the upper walls of the sheds and current collectors.

Development, however, did not cease when the standard type of crane just described and illustrated in Fig. 24 had been devised. The necessary increase

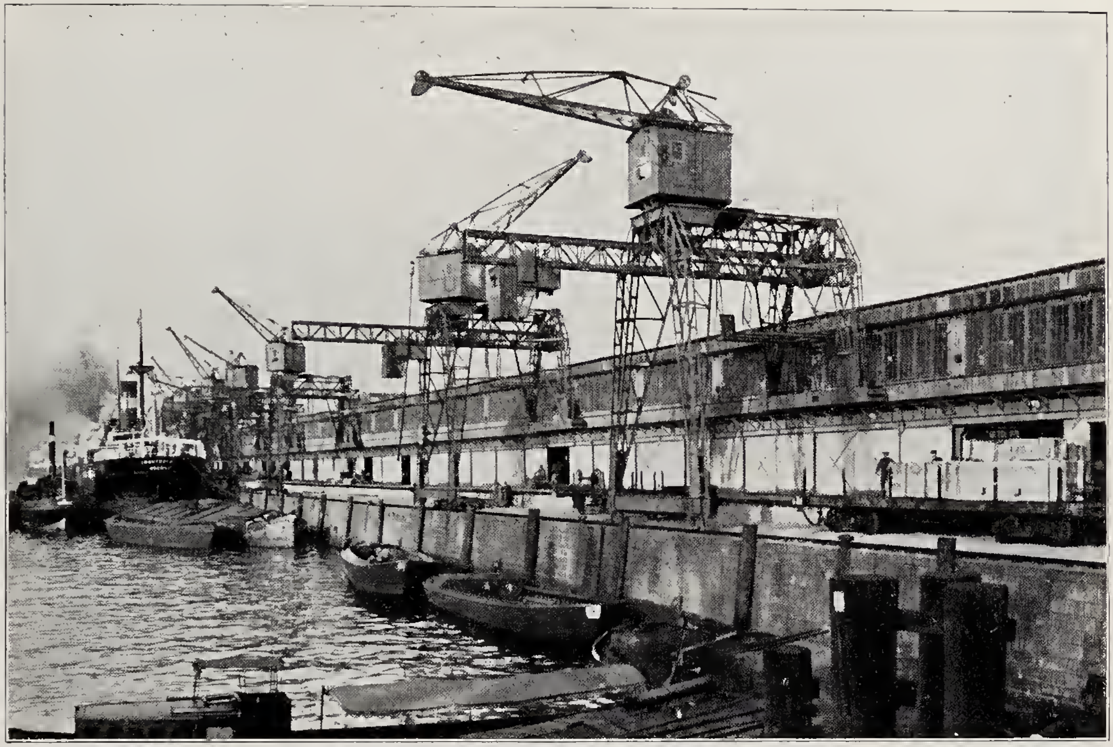


Fig. 26. Double Cranes on Australiaquai.

in the speed of all quay operations, and the special demands made in this respect during the past fifteen years, have caused a still more efficient type of crane to be devised. This is the so-called double crane (Figs. 26, 76) — a type which is the outcome of the experiments jointly conducted by the port authorities and the Deutsche Maschinenfabrik A.-G. (*Demag*), of Duisburg. The principle embodied by these double cranes has met with universal approval, and a large number of suggestions relative to the details of their operation have been put forward, but the Hamburg port authorities have not so far seen their way to modify their original design. The arrangement as adopted by them is as follows:

The gantry supporting the slewing crane is raised to such an extent as to admit the accommodation of a girder for a travelling crab. The girder may be withdrawn beyond the pier edge above the roof of the shed when not required for operation. The advantage of the travelling crab arrangement is that it can move the load in a straight line and at right angles to the pier edge. For this reason ordinary cranes with travelling crabs have been introduced with considerable success for handling the fruit cargoes on Versmannquai. The advantage of the slewing crane over the crab arrangement, on the other hand, is that the load may be moved about more freely. The combination of both devices in such a way that they may be operated independently of one another has resulted in a valuable increase in crane efficiency. The most recent additions to the number of these cranes have carried the principle of independent operation still further by the introduction of a type of jib for the slewing crane which is tiltable even when the crane is loaded. This is the *Demag* jib of variable radius. The lifting capacity of the slewing crane has been left at 3 tons. That of the crabs was 1.5 tons at first, but this figure was subsequently increased to 1.8 tons, and is now likewise 3 tons. The original arrangement was that the driver of the crab travelled along with it in a closed stand combined with it. Now, however, he guides the crab from a cabin built-in with the gantry of the crane. The various movements carried out, viz., lifting, lowering, and slewing the slewing crane, pulling-in the slewing crane jib, moving the crab jib inwards and outward, lifting the crab and making it travel back and forth, and the movement of the complete plant, are effected independently of one another by electricity.

Once the principle of the double crane had been adopted, the transition to the triple crane was only a question of time. This type contains two crabs instead of one, each of them having its own girder. When it was first introduced (Shed No. 81), it was found to be very satisfactory from the point of view of operation, and Shed No. 85, now in course of construction, will also be equipped with cranes of this type.

An additional innovation is that the standard type of slewing cranes — which, normally, are provided with jibs that are adjustable only when no load is carried — can now be equipped with jibs with variable radius (Nagel and Kaemp type of jib with variable radius), i. e., jibs that can be adjusted whether a load is carried or not. Moreover, the number of existing 3-ton cranes has been augmented by several 5-ton cranes for heavy loads. This increase of the lifting capacity by two tons has considerably facilitated pier operation. It does away with the inconveniences resulting from the employment of two cranes for the handling of loads just over 3 tons in weight, and — in many cases — with the necessity of towing ships to the giant cranes. As a rule, one 5-ton crane is sufficient for the needs of each berthing space. It is further intended to provide a number of 12-ton floating cranes for pier operating purposes. When this has been done, the necessity of towing ships to the stationary giant cranes will be practically restricted to the cases — not of very frequent occurrence — in which single pieces exceeding a weight of 12 tons are concerned.

Shed No. 85 (Rosshafen) may be cited as a typical example of a shed provided with modern crane equipment. It is now in course of construction, and will possess, when completed, the following cranes on the waterside: 6 standard 3-ton slewing cranes with ordinary jibs; 2 cranes of identical type, but having a lifting capacity of 5 tons, and being provided with jibs with variable radius; 4 double cranes of a capacity of twice 3 tons and provided with ordinary jibs; and 2 triple cranes of a capacity of three times 3 tons and having jibs with variable radius. These 14 cranes will have 22 crane hooks. As the length of the

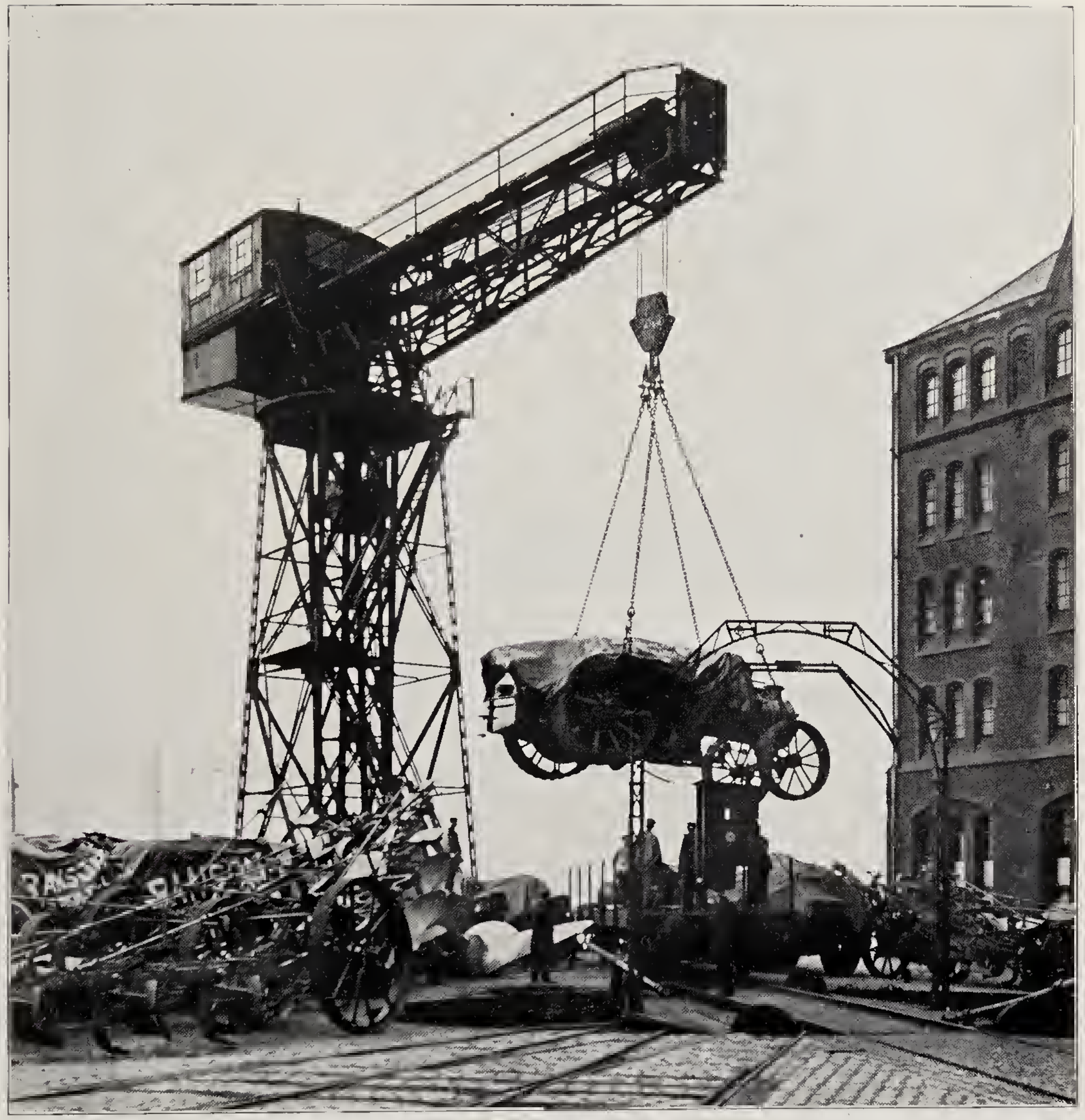


Fig. 27. A 30-ton Crane for heavy loads.

shed will be 950 feet, the average distance between two neighbouring cranes will be 68 feet, and there will be one hook to every 43 ft of space. Such equipment may be assumed to represent the maximum of movability and of adaptability demanded for the purposes of pier operation.

The shed referred to, like all others, is provided with lifting gear at its rear. As a rule, two stationary electric 3-ton wall slewing cranes are available, and their handling radius extends as far as the second rail track. The most recent sheds, moreover, have a crane of the same type at their narrow ends where most of the vehicular traffic is attended to, but its lifting capacity is 5 tons. The driver's stand, the lifting gear, and the lifting motor for these cranes are all accommodated in the interior of the shed.

In this context brief reference to those cargo-handling cranes may be found useful which are not directly concerned with the operations actually performed in or near the pier sheds.

The giant or mammoth cranes (Figs. 27, 78) already mentioned — which are used for the handling of very large pieces of cargo — are distributed fairly regularly throughout the harbour, and most of them occupy sites near the easily accessible pierheads. There are 10 of them altogether, their positions being as follows:

(a) Grosser Grasbrook area.
One 10-ton crane near the eastern extremity of Kaiserquai,
one 30-ton quay near the western extremity of Dalmannquai.
(b) Baakenhafen area.
One 30-ton crane near Oberhafen-Canal.
One 50-ton crane near Baakenhöft.
(c) Veddel area.
One 30-ton crane near Amerikahöft (O'Swaldquai),
one 30-ton crane near Kranhöft (Asiaquai),
one 150-ton crane near Kranhöft (riverside).
(d) Kuhwärder-Ross area.
One 10-ton crane near Reiherquai (Kaiser-Wilhelm-Hafen),
one 20-ton crane near Reiherquai (Kaiser-Wilhelm-Hafen),
one 75-ton crane near Kaiser-Wilhelm-Höft.

In special cases the giant cranes owned by the shipbuilding yards, more particularly:
the 200-ton crane of the Vulcan-Werke at Vulcanquai and
the 250-ton crane of Messrs. Blohm & Voss at Steinwärder Ufer,
are also available for cargo-handling purposes.

With one exception the giant cranes — like those used in connection with pier shed operations — are all driven by electricity. The exception is the 50-ton crane near Baakenhöft, but the electrification of its gear has been taken in hand. The old 150-ton crane near Kranhöft has already been provided with electric drive. The giant cranes are of the hammer-head type and are mounted on tower frameworks, except that the 50-ton crane and the 150-ton crane are jib cranes of an older type. The latest of the hammer-head cranes are provided with travelling crabs in the jib, and the highly efficient 250-ton crane of Messrs. Blohm & Voss has, in addition, a separate 10-ton crane travelling on the jib. The longer portion of the jib of this enormous crane can almost be raised to the vertical position, which however, has hitherto been necessary in connection with shipbuilding purposes only. The 75-ton crane is equipped with tipping gear for coal trucks.

Finally, some mention must be made of the lifting appliances with which the quays *(Freiladekais)* where the direct transhipment of cargo from ship to rail or *vice versa* takes place have been provided. Generally speaking, they are of the same type as the cranes used in connection with pier shed operations, except that they have had to be mounted on full portals instead of semi-portals because the quays in question have no sheds. These portals have a span extending over one or several railroad tracks. The biggest plant of the kind is that on Holthusenkai (Fig. 15), where all the cranes have a lifting capacity of 3 or 5 tons. They are equipped with single or twin chain grabs, because the cargo handled there consists for the most part of loose or heapable goods, such as coal, coke, and ore. Such automatic grab cranes are also provided in other parts of the harbour, e. g., on the quays specially set aside for the discharging of coal and on Kamerunquai (Sheds Nos. 60/62). They may be used to supplement the installations exclusively intended for the transhipment of loose goods whenever an emergency arises.

The following list contains a summary of the lifting appliances available in the port so far as they are used for goods transhipment, i. e. excluding those used for industrial purposes, viz:

(a)	10	giant cranes,
(b)	916	travelling cranes along the waterside of quay sheds and on the *Freiladekais*, including 44 double and 3 triple cranes,
(c)	178	stationary cranes on quays and embankments,
(d)	630	miscellaneous hoisting appliances in and attached to other buildings (warehouses, customhouses, etc.)
(e)	181	floating cranes and other hoisting appliances.
Total	1,915	

★

Mechanical Equipment used in the Quay Sheds.

The constant increase in the mechanical efficiency of the quay cranes could not have been turned to any practical advantage if the continued improvement of the equipment used in the interior of the sheds had not kept pace with it. There, indeed, the need for increasing the output by rationalising the methods of operation and by making enhanced use of mechanical power was still more imperative than at the water's edge. The cranes deposit the ship's cargoes on the shed platforms more or less promiscuously in the same order in which they happen to be stowed in the ship's hold, but before they can be conveyed to their proper places in the shed itself, they must be carefully sorted according to their marks and qualities and checked in conformity with the particulars contained in the ship's papers. Any mistakes in this work may cause a considerable amount of inconvenience and expense to consignees, and the quay administration must employ every precaution to prevent this. It is therefore unavoidable that the sorting and checking operations involve a material loss of time, and this disadvantage can only be neutralised by making the equipment used for short-distance transports as perfect as possible.

The smaller the individual lots of which the cargo consists, the larger must be the number of separate packages that have to be accommodated in the shed, and the larger must also be the number of separate piles that have to be formed there, as well as the number of passages that have to be kept open between them. Small individual lots, therefore, imply an unsatisfactory utilisation of the available shed space. Equally unsatisfactory results are caused when there is any delay in removing the discharged cargo, or when single lots have to be divided for the purpose of being sent to different destinations. The frequent occurrence of such conditions is a true indication of the present unfavourable position of international trade. The stagnation of business means additional inconvenience to the work of the quay operators. Nevertheless, the Hamburg authorities have speedily learnt to adapt their methods to the changes brought about during the past few years. Large though the increase in shed space (1,400,000 square feet, equal to 20% of the total space) has been since the war, it is not sufficient to meet the increased demands under existing conditions. Hence, the only possibility of surmounting the difficulties (apart from the improvement in the devices used for short-distance transports), has been to effect a better utilisation of the shed space, i. e., a more economical method of piling up the goods, and this could only be accomplished by improving the equipment employed for this purpose.

Lastly, the work of weighing the individual pieces handled in the sheds plays a much more important rôle now than it used to do in the past. The increased number of weighing machines and the increased space required for the business of weighing have necessitated a corresponding improvement in the efficiency of the former.

The three kinds of equipment, therefore, that next demand our attention, are the conveyances used for short-distance transportation, the appliances employed for piling up the discharged cargo, and the weighing machines.

★

Equipment for Short-Distance Transports.

The endeavours of the port authorities in the direction of producing a really practicable electric truck date back to the years immediately preceding the war. Up to then the hand-driven truck (Fig. 28) had been exclusively employed for short-distance transportation purposes. It was recognised, however, that the efficiency of the service cannot be increased indefinitely by augmenting the number of trucks and attendants, because the greater the number of the latter, the more must they stand in each other's way and obstruct each other's work. The complete elimination of hand-driven trucks from the operations going on

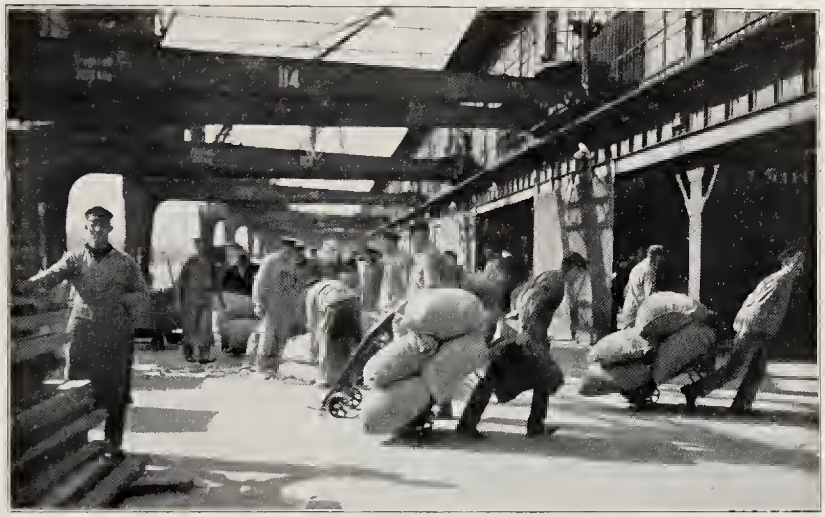


Fig. 28. Hand Trucks used for the Transportation of discharged Sack Goods.

in the quay sheds can probably never be achieved. It would only be feasible if the goods discharged from the ships and landed on the quays were already sorted according to their marks. What must be aimed at, is the utmost possible cooperation between the ship and the shed. The electric truck can be used in a remunerative way only where it can travel without interruption from the crane to the piles of discharged goods, and *vice versa.*

The Hamburg authorities, therefore, devoted their attention first of all to the perfection of the hand-driven transportation devices. Different types, each of them particularly suitable for the transportation of a particular kind of cargo, have been introduced. The chief among them are: sack carts (Fig. 28) a type that can be used in numerous ways and that has been perfected in every detail; low iron four-wheel trucks; tall carts with large platforms suitable for wet hides and bulky goods; iron trucks for the transport of bales of dried kips, provided with slanting platforms for hides that have to be piled up in uprgiht fashion; trucks for heavy barrels permitting the latter, owing to the special four and six-

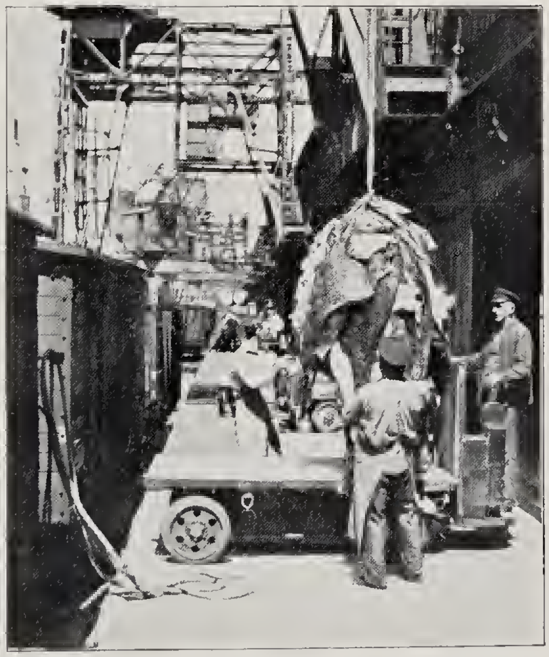


Fig. 29. Electric Trucks used for the Transportation of discharged Hides.

wheeled barrows for the transport of heavy packing cases, and a design of the trucks, to be easily handled by one single attendant; small low number of others.

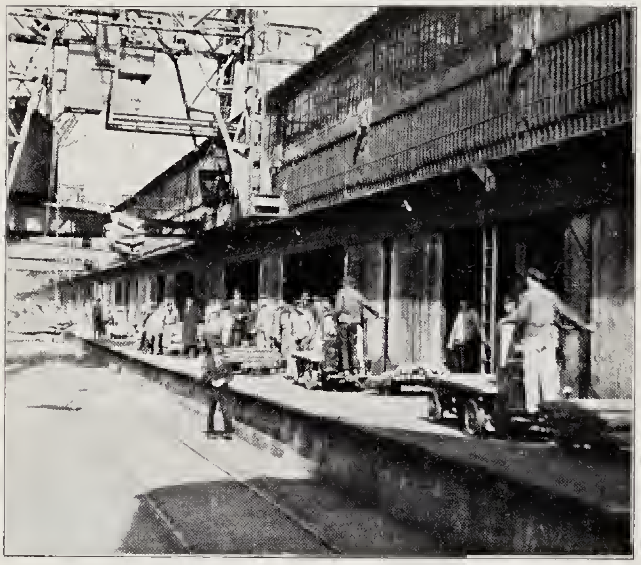


Fig. 30. Electric Trucks used for the Transportation of discharged Copper Bars.

All these various types of hand-driven trucks and carts, however, have to a certain extent been replaced by electric trucks (Figs. 29, 30) during the past five or six years notwithstanding the limitations above alluded to, or have been subordinated to them for the purpose of being used as trailers. The electric trucks are especially suitable for conveying to lighters and barges such cargoes as have already been sorted (the work of sorting having been found rather a hindrance in connection with electric trucks). It is nothing rare nowadays to see as many as thirty electric trucks being employed in one single shed. There are two types of them, viz., those without a platform, which are exclusively used to pull trains of specially constructed trailer carts, and those with a platform which are themselves employed to carry the loads. The former have only been introduced to a limited extent, because their work can really be done just as well by the latter kind which, therefore, is more remunerative. The driving power for the electric motors is obtained from powerful storage batteries carried by each truck which are sufficient to last for an eight-hour shift or more. The accumulators are charged at a centrally situated charging station to and from which the batteries are conveyed by motor lorries. In order to avoid any interruption of the service, provision has been made for a number of spare batteries that may be substituted on the spot for the exhausted ones. Among the numerous makes produced in Germany those possessing the maximum amount of dirigibility have proved most useful, because this feature is of decisive importance in view of the narrowness of the passages between the piles of goods in a fully occupied shed.

The majority of electric trucks have been supplied by Messrs. Allgemeine Elektrizitäts-Gesellschaft, of Berlin (Fig. 29), and Messrs. Siemens-Schuckert-Werke, also of Berlin, whose products are fitted with four-wheel steering. Other makes, however, e. g., those of Messrs. Adolph Bleichert Company, of Leipzig, and Messrs. Hansa-Lloyd, of Bremen, are also represented. The carrying efficiency of most of the trucks is about 3,300 lbs. Two trucks, therefore, are sufficient to transport, at great speed, the entire load of a three-ton crane used to its full capacity. Thanks to the continuous contact maintained between the harbour authorities and the manufacturing firms the electric truck has been developed into a most useful accessory to the work of quay operation. Shipping has profited from its introduction by the considerably accelerated despatch of the vessels that is now possible. A somewhat different type of electric truck is the single-axle truck brought out by Messrs. Amme-Luther, of Brunswick. It requires the attendance of one workman, is provided with two steering handles, and serves the purpose of shifting the position of railroad cars and cranes not yet equipped with their own travelling engines.

★

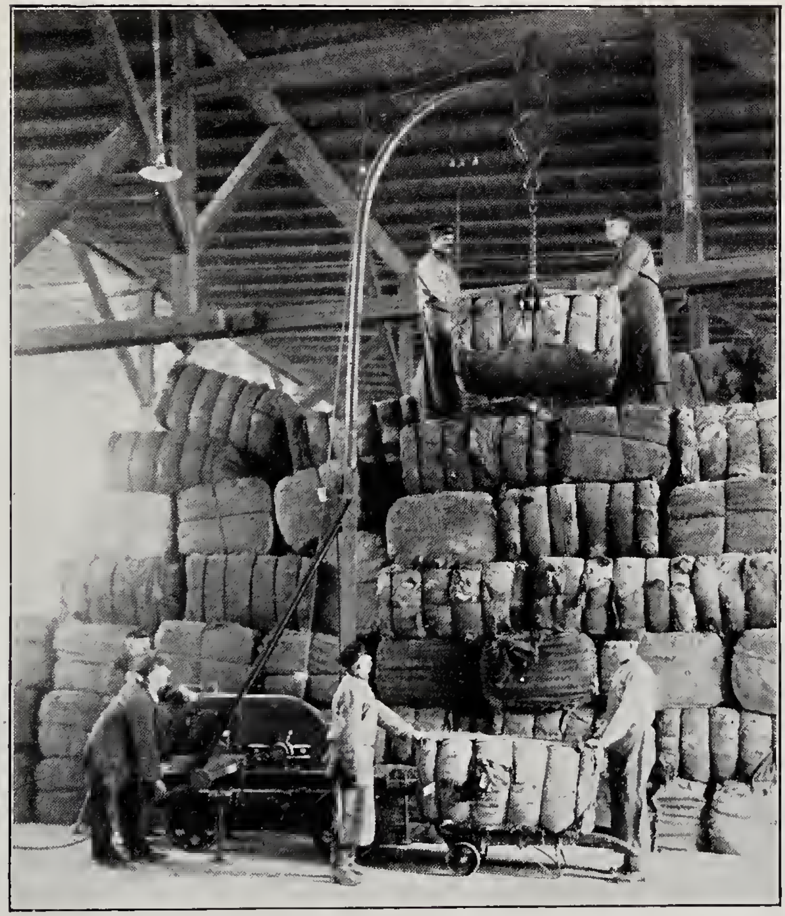


Fig. 31. Winch used for piling-up Cargo.

Equipment for Piling up Cargo.

The second important group of mechanical quay shed equipment consists of the appliances for piling up discharged cargo. After testing various methods and devices that were found impracticable and therefore abandoned, e. g., the so-called jumping method with the aid of a shod bar, the conveyor-belt elevator method, etc., the electrically operated piling-up winch (Fig. 31) with tall curved jib of 6 feet projection has proved the most suitable mechanism for piling up any kind of goods. It has been designed by Messrs. Eisenwerk, vorm. Nagel & Kaemp A.-G., of

Hamburg, in conjunction with the port administration, and is manufactured by the former. It is supplied in two types of 660 and 1,220 lbs lifting capacity respectively. The easily reversible jib, which is made of Mannesmann tubes, may be used in two different lengths, according to the available height. It permits the erection of piles up to 13 ft. The lifting and turning movements are effected by means of electric power. In order to keep the price of the winches — of which very large numbers are in use — as low as possible, electric traversing gear has been dispensed with, and ordinary hand drive, which has the advantage of securing very smooth operation, has been resorted to. As a rule, this appliance has been found suitable even when several neighbouring piles of goods alternately supplied from the ship's hold are served by it.

In certain cases, however, a more rapid readjustment of the piling-up mechanism is required, and sometimes a combination of the work of transportation and piling-up is considered indispensable. Three types of combined appliances, consisting of an electric truck and some kind of lifting gear (Fig. 32) have hitherto been employed in the quay sheds. The travelling cranes (electric truck and overhead traveller with slewing jib) made by Messrs.

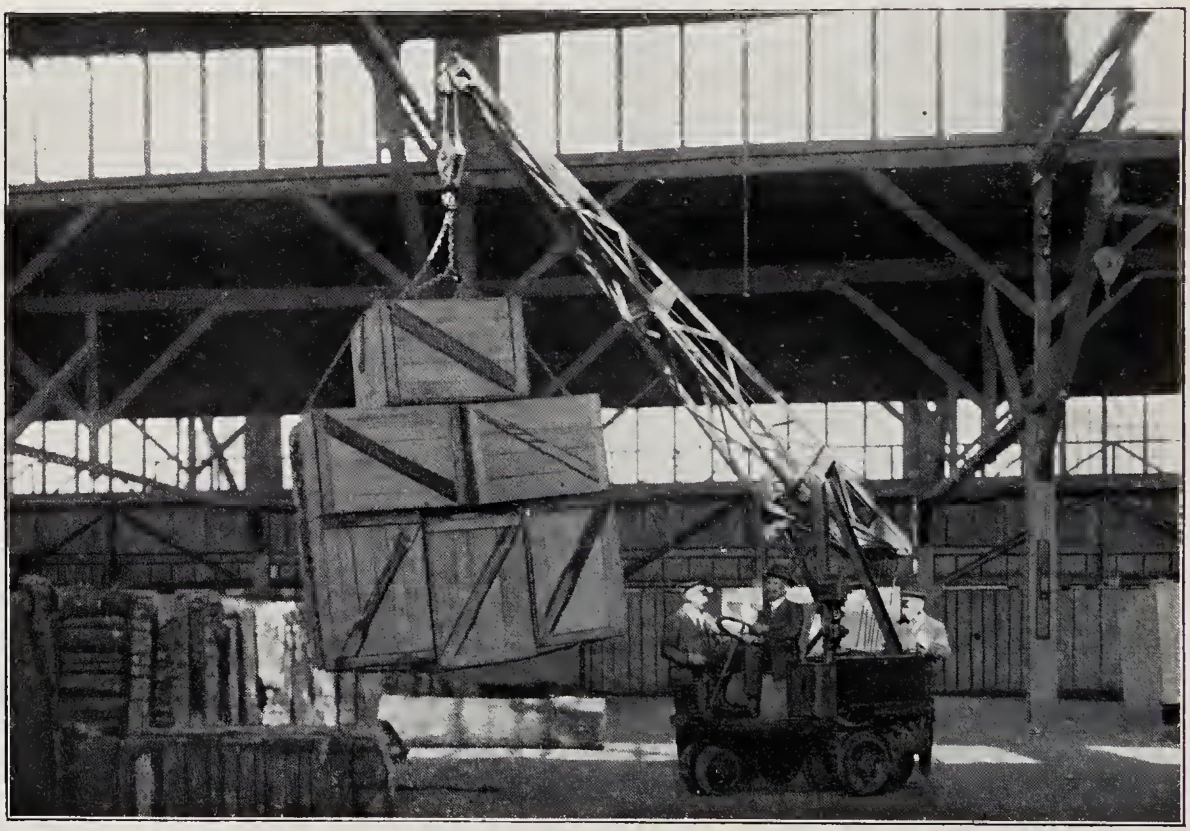


Fig. 32. A Travelling Crane.

Linke-Hofmann-Lauchhammer A.-G., of Lauchhammer, and Messrs. Amme-Luther, of Brunswick, are entirely driven by electric power, and their travelling gear is designed in such a way that they can turn round at any moment wherever they may be at the time. They possess a lifting capacity of one or two tons, and their usefulness is very varied. They are especially suitable for the handling of heavy pieces, and have contributed very considerably to the remunerative working of the Hamburg quay sheds. The only cargoes for which they are not very suitable are engines or motor cars packed in cases, and similar bulky goods. For this kind of work the electrically driven Yale lifting trucks, an American invention, have proved extremely helpful, and some of them are now installed in several sheds. The platform of the Yale trucks can carry loads up to 1.8 tons, and this load can be raised to the extent of 6 ½ ft. A slight lift is sufficient to place transport wheels underneath such cargoes. If the pieces are very large, two such trucks are used.

★

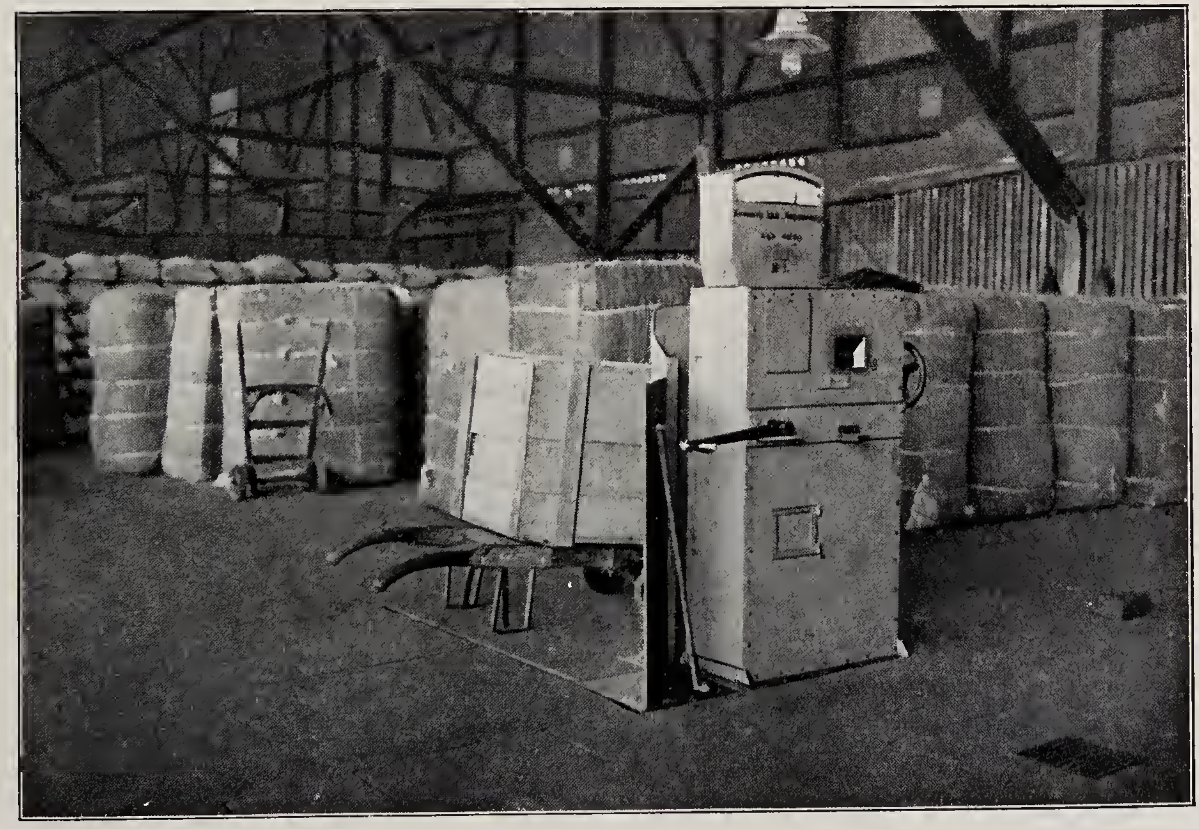


Fig. 33. A Semi-automatic Weighing Machine.

Weighing Machines. The weighing process which used to involve a great loss of time has been very considerably accelerated by increasing the number of weighing machines, their carrying capacities, and their general efficiency. The rule in the more modern sheds is that each is equipped with fifteen stationary weighing machines whose platforms are sufficiently large and solid to accommodate electric trucks or their trailers. The increase in their carrying capacity has kept pace with the increased capacity of modern cranes. Each shed, in addition to the usual one-ton weighing machines, is equipped with several three-ton machines, and the very latest sheds are even provided with five-ton machines. The old decimal balances are no longer suitable for present-day requirements, and the same remark applies to the centesimal weighing machines with sliding poise which are far too slow in operation and not reliable in their results. Neither of these two types is installed any longer. The most useful machine for quay operation, which is the outcome of numerous trial experiments, is the semi-automatic combined adjustment and inclination balance as manufactured by Messrs. Ottensener Waagenfabrik Albert Essmann & Co. (Fig. 33). It is designed in such a manner that the approximate weight of the load (correct to the nearest 100 kilograms) is shewn by a simple adjustment device, whereas the kilograms below 100 and fractional parts of a kilogram are indicated automatically by a pointer. Errors are practically impossible, and the whole process of weighing is very greatly simplified as compared with the older systems.

★

Coal Tipping Devices. Among the remaining mechanical equipment used on the quays the two very up-to-date plants for the transhipment of coal from the railroad to the ship deserve special mention. They are the wagon tipping devices on Kirchenpauerquai and Hofecanal respectively. The former plant is used for transferring the coal to sea-going vessels, and the latter for transferring it to barges or lighters. The most typical feature of their design is that the coal, instead of being first tipped into a chute and then into the vessel, is dropped straight into the ship's hold out of the coal truck which is held in a slanting position far beyond the edge of the quay wall. This arrangement means that the way the coal has to travel is shortened, and that any deterioration of its quality due to crumbling (which is unavoidable when chutes are employed) is prevented as much as possible. The tipping device for sea-going vessels (Fig. 34) is equipped with a platform for the coal truck that can be raised to such a level that the coal drops straight into a funnel whose telescopic outlet can be adjusted to the height of the pile of coal that may have accumulated from time to time in the ship's hold. The force of gravity is made use of to effect the actual tipping. The whole appliance has been described as a slewing coal tip, owing to the slewing lever with which it is provided. Its efficiency is twenty coal trucks an hour. The most salient feature of the tipping device for rivercraft is that the tipping platform can be made to travel along a bridge arranged at right angles to the quay wall and projecting beyond it, so that the coal can be distributed over the whole width of the vessel or over several vessels lying alongside of one another. Thus trimming is entirely dispensed with. Tipping is effected by the provision of curved tracks for the tipping wagon carrying the coal truck on which the front rollers of the former are made to move downward whilst the rear rollers are simultaneously caused to move upward.

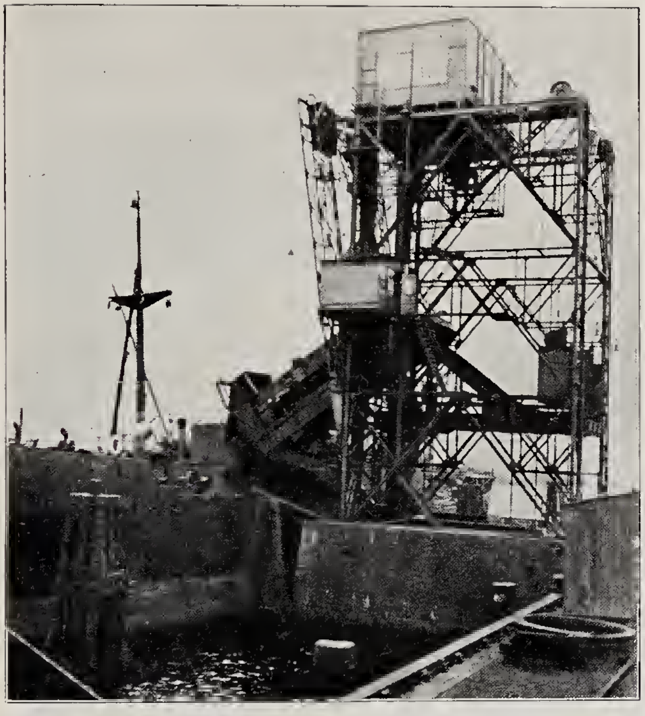


Fig. 34. Coal Tipping Device on Kirchenpauerquai.

★

Mechanical Equipment used for Midstream Transhipment.

In contrast with the coal tips just described which may be said to represent a type specially characteristic of the methods used in the Port of Hamburg, the remaining equipment for the handling of bulk goods does not, generally speaking, shew any conspicuous deviation from that employed everywhere else. With the exception of the loading bridges for coal (Figs. 14, 35) which form a variety of combinations of hoisting devices, the equipment mainly consists of floating apparatus used in connection with midstream transhipment, such as floating cranes (Fig. 36), floating steam winches, floating automatic grabs (Fig. 37), coal elevators (Fig. 35), and grain elevators (Figs. 38, 79). Owing to the considerable trade in bulk goods, their number is very large, and there is much diversity of type among them. Here it must suffice to state in summary fashion that 123 floating steam winches, 22 floating cranes (whose capacities are up to 100 tons), 8 floating automatic grabs, 6 coal elevators, and 22 grain elevators are available in the Port of Hamburg, so that the existing facilities are sufficient to cope with any requirements that are likely to arise.

★

The Warehouses.

We now leave the subject of the equipment employed for the transhipment of goods and turn our attention to the facilities for warehousing and storing provided within the harbour area. The warehouses differ very materially from the transit sheds, the chief difference being that they are built several stories high and that they are of solid construction throughout. The general appearance of a large section of the harbour, the "warehouse city", is dominated by them (Figs. 39, 40). Their fundamental design is shewn in Fig. 40. Generally speaking, the depth of the warehousing rooms is 100 feet. Each consists of a basement, a ground floor, and five or six upper floors whose average height is about 10 feet. The maximum loading capacity of each floor is 370 lbs to the square foot. The designs of the ceilings and supports have been mainly determined by considerations connected with the risk of fire. Wrought-iron pillars and exposed girders have been avoided, extra strong wooden constructions (and in some cases reinforced concrete) having been used instead. In order to minimise the danger zones in the event of fire breaking out, no

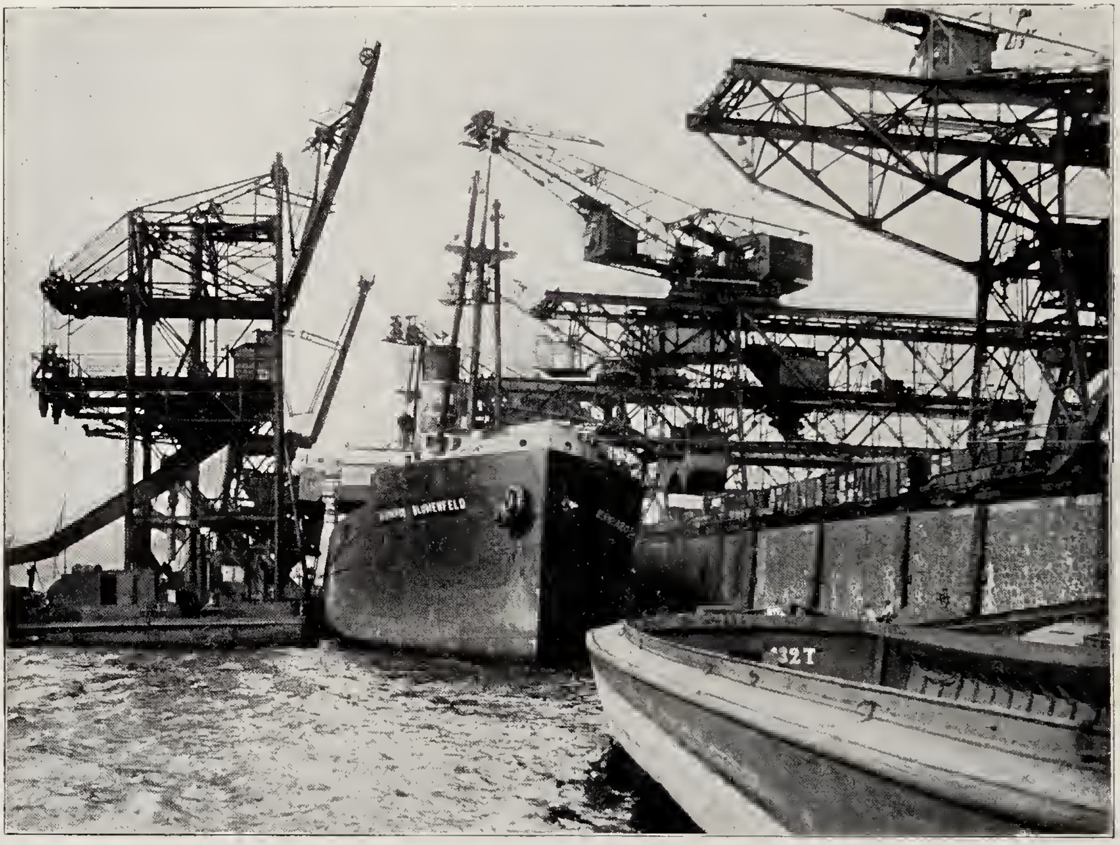


Fig. 35. Coal Loading Bridges and Floating Coal Elevators.

single room is allowed to exceed 4,300 square feet in floor space. Adjacent warehouses are separeted from each other by fireproof walls. By means of galleries it is possible to reach one building from another, whilst fireproof spiral staircases provide safe exits to the road. In addition to the warehousing rooms, the buildings contain ample accommodation for office premises. A number of hydraulic winches, arranged above the vertical hatches, serve to transfer the storage goods from cart or lighter to the warehouse. The style of architecture corresponds to the taste of the eighties and nineties of the past century, the period during which most of the warehousing blocks were built.

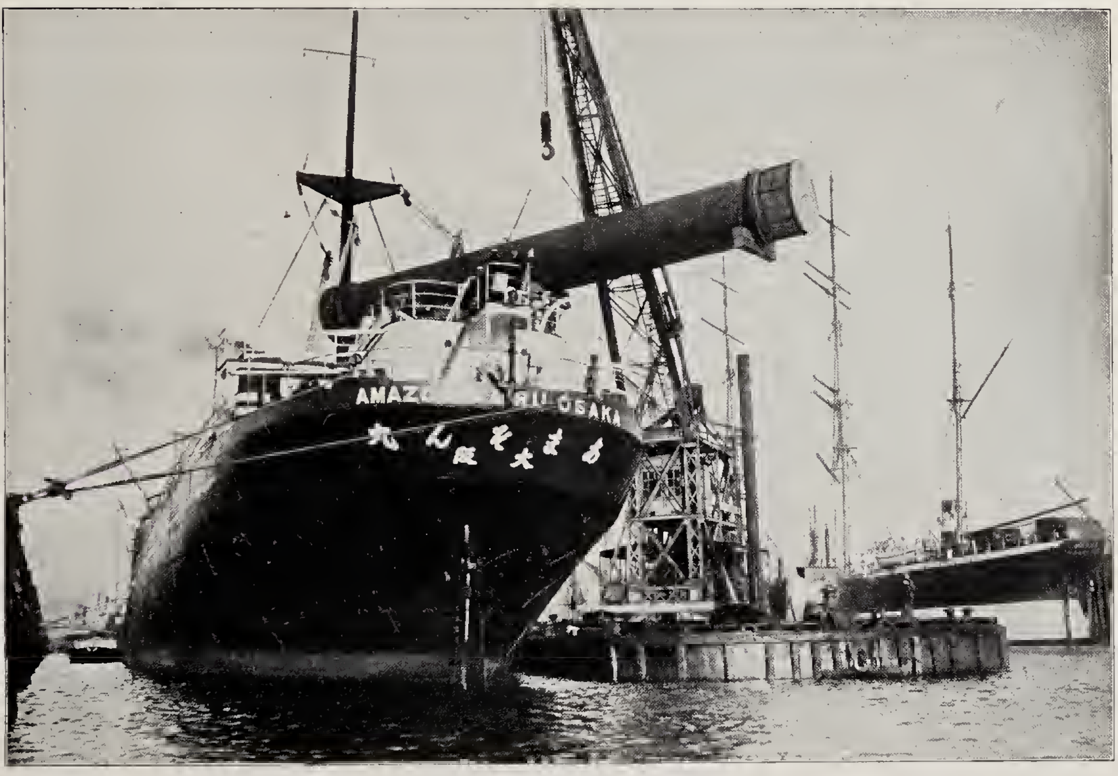


Fig. 36. A Floating Crane.

The eight warehouses on Melniker Ufer and Dessauer Ufer are much lower than those in the "warehouse city". Some of them are without upper stories altogether, and resemble the quay sheds in their general appearance. Since, however, the piles of goods in these warehouses are generally much higher than in those provided with upper stories, they have been amply equipped with mechanical devices for piling up the commodities.

The total available warehousing floor space, after the completion of two warehouses now building, will be 126 acres, so that there will be accommodation (on the basis of the maximum loading capacity above stated) for 1,000,000 tons of goods simultaneously.

Shore Protection. Quay operations and warehousing work alike necessitate the provision of solid quay walls and embankments for protection against the elements. These have been described in a preceding chapter. Nowhere in the harbour has it been found possible to limit shore protection to the sloping embankments that go down to the water surface at a low angle. Some sort of additional equipment is necessary to guard the shore against deterioration and the inroads of water. Therefore not only the vast majority of the canal banks, but also the whole river frontage at Waltershof, the banks of Petroleumhafen, and other parts have been reinforced in some way or other. The method most generally used for this purpose is the provision of closely linked-up sheet piling or pile planking secured in its position by some stiffening in front or in the rear. The details of its design correspond to those already described in the chapter on the quay walls. The wooden part of the structure emerges as little as possible above M. L. W. The top portion of the piling is reinforced by cross beams and is surmounted by the paved work of the sloping embankment.

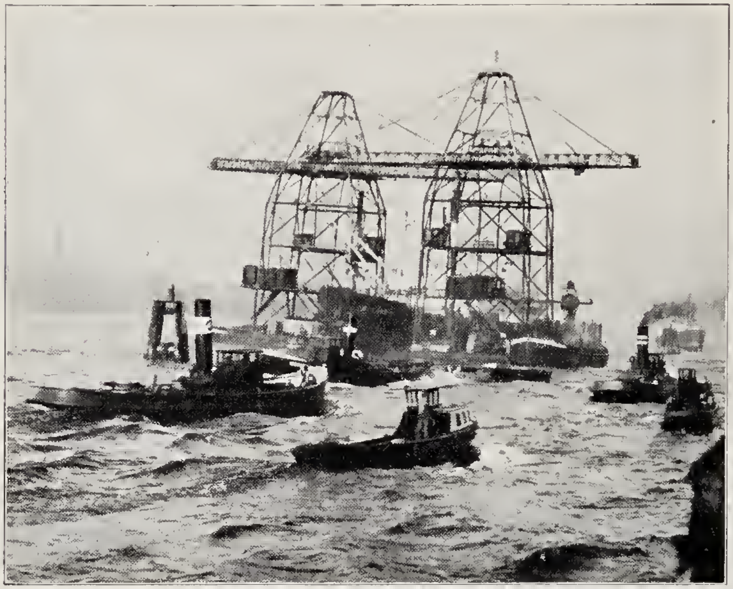


Fig. 37. Floating Grabs.

★

The Locks. There is a great deal of similarity between the shore protection work and the construction of the locks. The reason why some locks had to be provided in the harbour area has already been stated on a previous page where it has also been pointed out that the difference in the level of water above and below them is never more than a few inches. Consequently lock gates of a light type have been found sufficient for opening and closing the lock chambers. The latter can be moved rapidly and without much force. The increase in the measurements of successive locks has kept pace with the development of the types of vessels using them. The following data are instructive in this respect.

Name of Lock	Date of Building	Length of Chamber in feet	Width of Lock Gates in feet	Depth of Sill below M.H.W. in feet
Brookthor-Schleuse	1869	216	38	13
Baaken-Schleuse	1889	328	52	15
Grevenhof-Schleuse	1900	393	60	18
Ellerholz-Schleusen	1906	393	60	18
Müggenburger Schleusen	1906	393	60	18
Rugenberger Schleusen..	1913	490	60	20

The Ellerholz, Müggenburger, and Rugenberger Schleusen are double locks, two single locks having been arranged parallel to one another. The gates of the older locks are provided with hydraulic drive, and those of the later ones with electric drive.

A short description of the Rugenberger Schleusen may serve to illustrate the technical principles involved. The lock crowns resemble the quay walls as regards their design. They support the iron girders for the two lock gates. The latter are made of iron and have wooden facings. Above and below they are guided by horizontal rollers. They are suspended from the girders by means of vertical rollers. The lower portion of each gate consists of an air chamber which serves to maintain it in a more or less floating position. The lock chambers are surrounded by masonry in their lower half, which is intended to support the sloping earthwork above. The driving engines for the gates are accommodated between the two chambers. Both halves of each gate open and close simultaneously, and their movements can be regulated by a brake arrangement before they reach their final positions. Control is effected from an attendant's cabin on each of the lock crowns.

★

The Dolphins.

Owing to the great practical importance of midstream transhipment, which is so considerable that more than 45 miles of berthing space have been provided for it, the dolphins or mooring posts have become one of the most conspicuous features of the harbour. However simple the construction of such groups of wooden piles may appear to the cursory onlooker, it has its technical mysteries all the same. The present development of dolphins may be said to have originated from the single posts used in canals and basins used by harbour lighters for the purpose of making fast these small vessels when berthed there. The dolphins provided in the basins used by the numerous up-river barges consist of two, three, or four single posts and a simple wooden connection. In the rivercraft basins their average distance from each other is about 80 feet.

Fig. 38. A Grain Elevator.

Groups consisting of from nine to sixteen posts are provided in the basins for sea-going vessels of light draught, whereas in those basins where sea-going vessels of deep draught are berthed, groups of twenty-four single posts are the rule. Formerly the normal arrangement was to provide one central post around which the others were grouped, but modern harbour engineering prefers two groups arranged in concentric circles without a central post (Fig. 41). The posts forming the outer circle are slanting less than the inner ones. The wooden stiffenings and the mooring rings are fitted in such a way that all outward projections are avoided. This affords the greatest possible protection of ships and dolphins alike against all kinds of damage. The ends of the rows of mooring posts are in some instances equipped with ice guards with iron-plated fender beams. The average distance between groups of dolphins in the latest type of basins used by sea-going vessels is about 115 feet.

★

The Landing Places.

Dolphins are also used for the protection of all those structures in the harbour that are particularly exposed to damage through violent contact with ship's hulls. This applies more especially to the floating landing stages.

In designing the various kinds of landing places, the fluctuations in the level of the water surface had to be taken into account. Where traffic is not very brisk and where only small-sized vessels, such as harbour launches, are concerned, landing stairs leading down to low-water level have been provided. Only the step that happens to be level with the water according to the state of the tide can be used at a given moment so that no more than one person can embark or disembark at a time. In some instances floating booms or iron pontoons are placed before these landing stairs. In the basins for rivercraft where the embankments are sloping, narrow wooden bridges connected with stairs are provided at distances varying between 330 and 1,300 feet. Stairs of solid construction are also used in some parts of the quay walls lining the basins for sea-going vessels.

Simple arrangements like the foregoing, however, are inadequate where traffic is brisk. There it is necessary to establish facilities enabling numbers of persons to board or leave the vessels simultaneously. This applies in particular to the landing places of the vessels engaged in the regular ferry-boat services (Figs. 59, 65, 77). The method adopted in their case consists in the provision of movable bridges supported, by means of rollers, on floating pontoons. Their slope depends on the level of the water at the time in question. Wherever the available space permits, the bridge is not

Fig. 39. Warehouses of the Freihafen-Lagerhaus-Gesellschaft.

made to rest on the actual landing pontoon, but on another one specially provided for the purpose. By this arrangement the danger of the bridge and its sensitive bearings being injured by the bumps of the arriving steamers is greatly reduced. When the bridge pontoons have to be temporarily removed for repair, the bridge itself can be suspended from posts. In order to avoid any dislocation of traffic on that account, provision has been generally made for movable stairways leading down to the landing stage. A special device used in their construction ensures that all the stairs retain their horizontal position whatever the angle of inclination of the whole stairway may be. The height of the landing stages above the level of the water ranges between 2 ft 7 ins and 3 ft. They are protected from accidental damage by means of the dolphins already referred to.

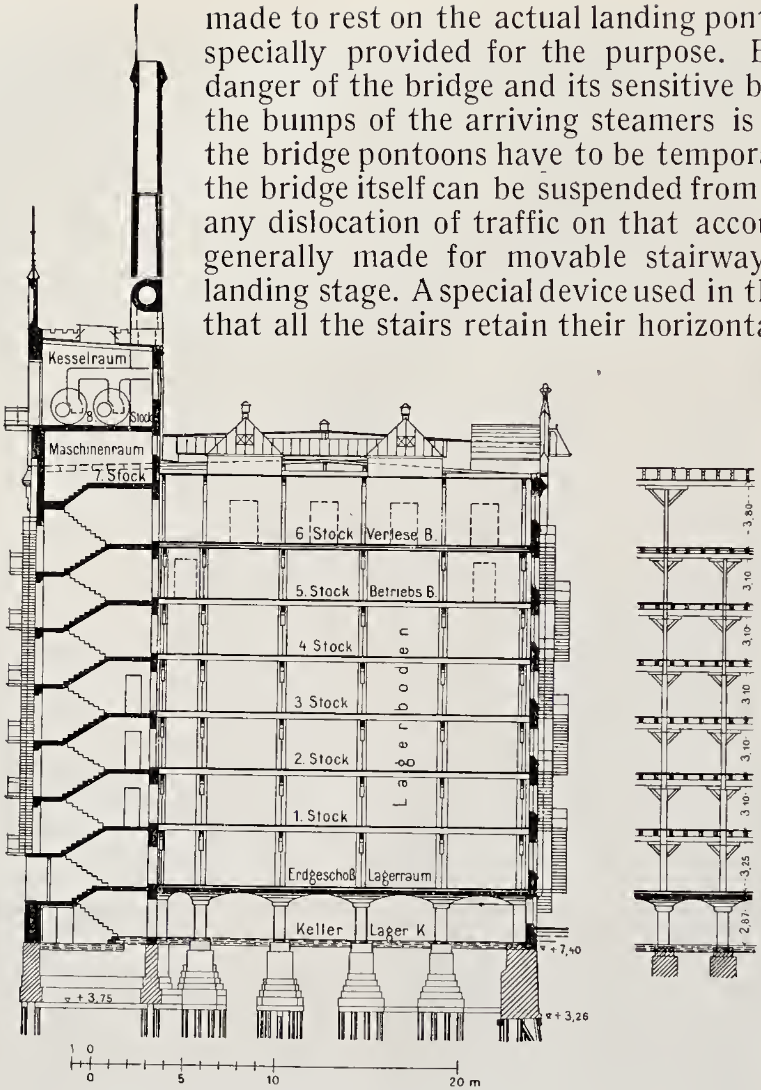


Fig. 40. Cross Section of a Warehouse of the Freihafen-Lagerhaus-Gesellschaft.

The details concerning the design of the landing stages on Stadtdeich used by the boats engaged on the Upper Elbe and of those on Strandquai frequented by the passengers from sea-going steamers landed there correspond to those just described.

The largest of all landing places are the St. Pauli Landing Stages (Figs. 9, 42). Owing to the very considerable traffic they have to cope with, they are of a type somewhat different from the others. They were constructed in 1907/1909 in that part of the harbour which has now for almost a century been the junction of the city's local traffic and ocean-going shipping, and partly replace an older, but much smaller structure. They are not really a number of separate landing stages, but form one solid iron structure with wooden flooring. They are 1,400 feet long and 66 feet wide, and are supported by 109 floating iron caissons. Their surface rises 6 ft 4 ins above the water level. Their rear portion contains accommodation for waiting halls, offices, luggage rooms, and shops.

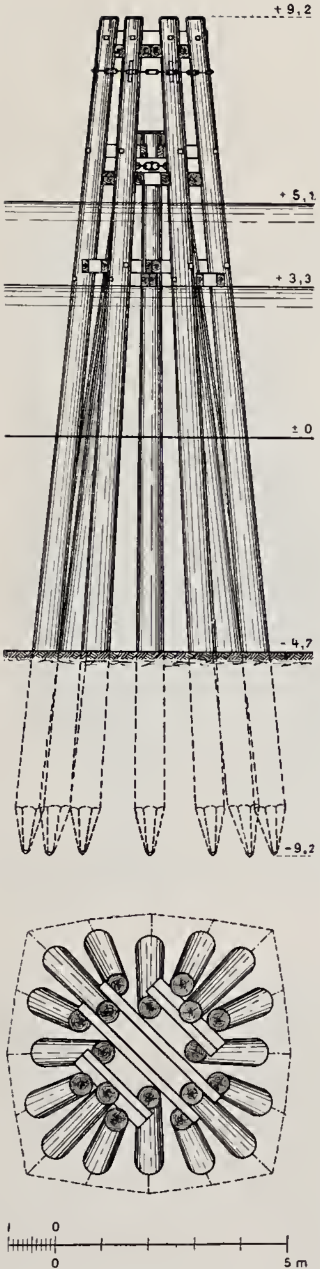


Fig. 41. Dolphin consisting of sixteen Mooring Posts.

Facilities for the landing of small launches have also been provided there.

The eastern part of the St. Pauli Landing Stages carries an upper deck 660 feet long and nearly 10 feet high, where sea-going vessels can disembark their passengers from their promenade decks.

The shore connections consist of nine movable bridges, each of which is about 100 feet long. Seven of them lead to the main platform, and two to the upper deck of the landing stages. The width of the bridges is about 29 feet, except that one of them is narrower. They are large enough to cope with any traffic however considerable it may be.

A reception building — similar, as regards the purposes it serves, to a railway reception hall — has been provided on the part of the shore directly adjacent to the Landing Stages. All the bridges are approached by passages leading through this building which contains, among others, a big cloak room, office premises, officials' quarters, booking offices, and a restaurant. An interesting view of the brisk traffic in the harbour is obtainable from the roof (which is low and flat), and it is therefore used as part of the restaurant. Several domes surmount the various sections of the imposing building, and its eastern end has been designed as a tall clock tower equipped with a tide gauge indicating the level of the water above Hamburg zero expressed in decimetres, and with the light signal already described.

* * *

The Customhouse Clearing Stations.

Floating pontoons similar to those forming the main part of the landing stages have also been employed for some of the structures used for customs purposes.

The boundary line separating the Free Port from the customs area has a length of about 17 miles. Its shore portions are guarded, in most places, by strong palisades nearly ten feet high (Fig. 43) whose upper half consists of strong iron wire gauze within an iron frame work, whereas their lower half is made of sheets of corrugated iron which are continued for some distance underground so that it is impossible to smuggle any commodities from one area to the other. Where the line crosses the water, it is marked by double wooden fences mounted on wooden or iron floating bodies. These floating palisades are strengthened by groups of posts placed at certain distances from each other (Figs. 59, 77).

Some of the custom-house clearing stations are accommodated on pontoons closely resembling those used for the landing stages. The floating stations, e. g., those in Niederhafen and Brookthorhafen, are equipped with cranes and are roofed-in. Some custom-houses, e.g., those in Müggenburger Zollhafen and in Entenwärder Zollhafen, are provided with sheds where the traffic crosses the customs boundary.

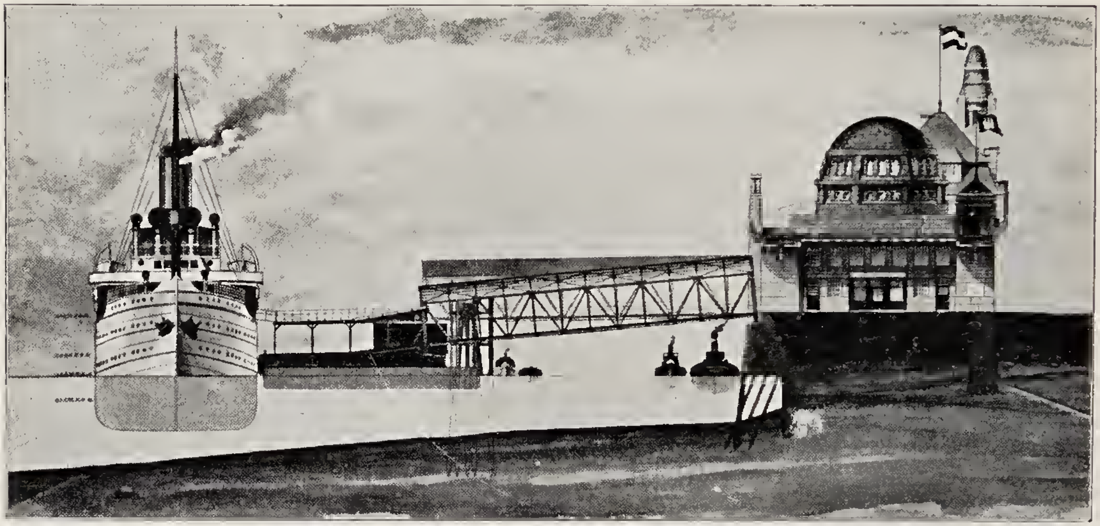


Fig. 42. Cross Section of St. Pauli Landing Stages.

Generally speaking, the individual differences between the various custom-houses, etc., enumerated on pages 59 to 60, are so great that a detailed description cannot be given in this place. They are due to local peculiarities and to the nature of the traffic mainly attended to by the stations in question. A feature common to all is that their designs and their equipment are capable of satisfying all the demands of the traffic moving from the Free Port to the customs area and *vice versa* — demands which are sometimes very considerable.

★

The Köhlbrand Train Ferry.

The requirements expected to be satisfied by the Köhlbrand Train Ferry (Fig. 44), to which reference has already been made in the chapter dealing with the railroad facilities of the Port of Hamburg, are so heavy that a separate description will be given below. It stands to reason that the transfer of railroad trucks from the vessel to the shore demands a far greater precision in the construction of all parts than the conveyance of passengers. A special difficulty is presented by the varying level of the water. The difference between the two extreme levels that have to be taken into account for practical purposes (i. e., + 5 feet at a very low tide, and + 21 feet at a very high tide) is so considerable that an adjustment cannot be effected by movable bridges, because these — in order not to exceed the maximum angle of inclination admissible for railroad operation — would have to be extremely long. Hence, the adjustment had to be made by the ferry boats themselves, and these had to be constructed accordingly. The carrying deck of each boat is suspended from eight screw spindles by means of which it can be raised or lowered according to the level of the water. It is thus possible to make the carrying deck always level with the shore. The floating body of the boats, in order to comply with the requirements just described, has been equipped with a tall iron superstructure consisting of four portals and longitudinal reinforcements, and surmounted by the wheel house. The deck is provided with two railroad tracks. It can accommodate six railroad trucks as well as a considerable number of passengers. The boats can carry any other kind of vehicles besides railroad trucks. They are completely symmetrical and have two screws each forward and aft, so that they can land their cargoes, etc., without having to turn — which, owing to the traffic moving up and down the Köhlbrand — is a great advantage. It saves time and increases the safety of the service. Steering is effected from the wheel house by means of the screws, that is to say, from the ship's engines direct. This ensures the free navigability of

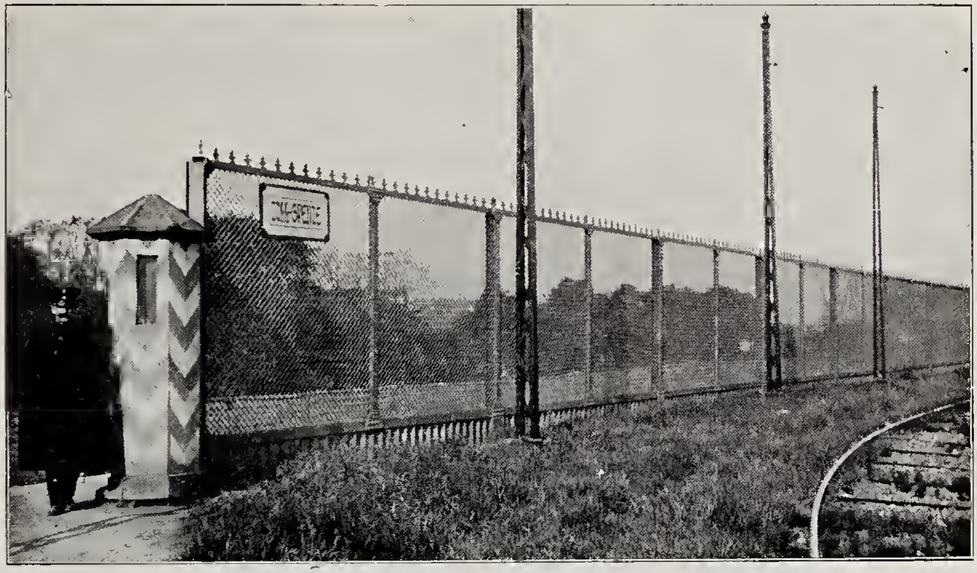


Fig. 43. Customs Barrier ashore.

the boats even when travelling at the low speed required just before landing. The following are the principal data of their construction.

Length of boat	120 ft
Width of boat	50 ,,
Height of boat	12 ,,
Draught	8 ,,
Length of movable deck ...	110 ,,
Width of movable deck ...	40 ,,
Speed	8 knots.

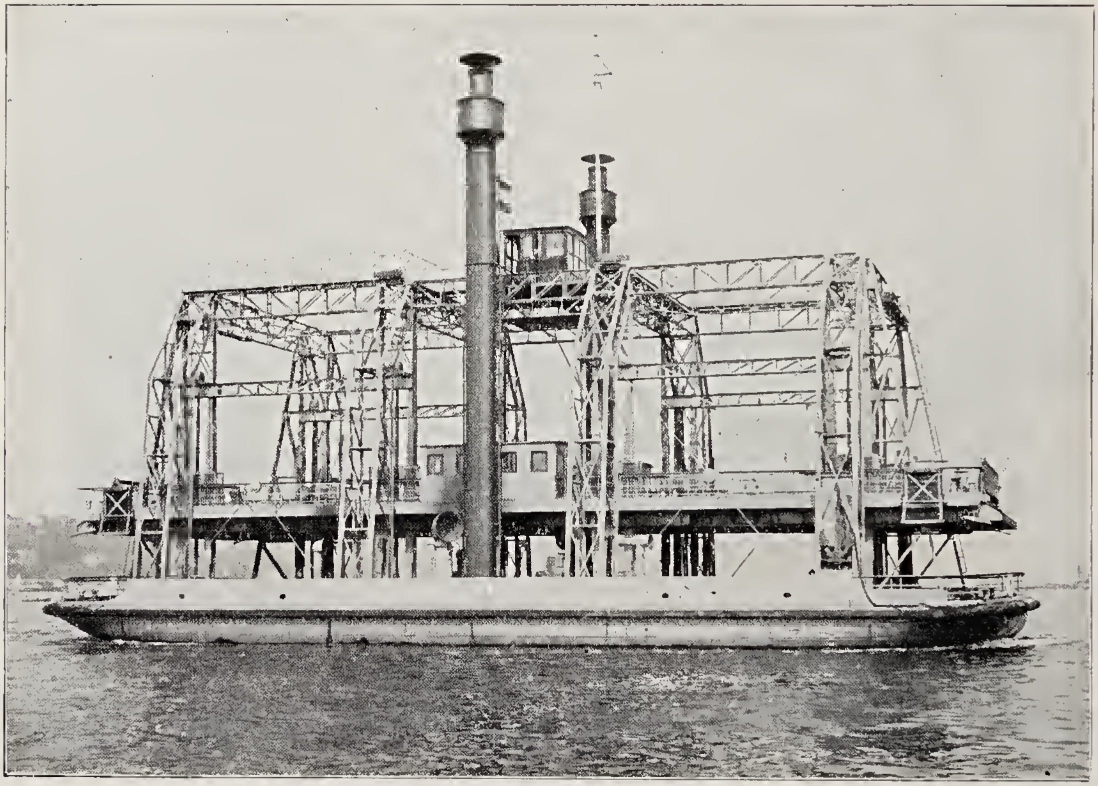


Fig. 44. The Köhlbrand Train Ferry.

Driving power is obtained from two steam engines indicating 320 H. P. each. The two funnels are situated midships at either side of the vessels.

The ferry boats just described were built by the Vulcan yard, of Stettin, in 1912. Their navigability is very good, even when the weather is fairly rough. They were temporarily employed to establish some sort of railroad connection with the Deutsche Werft, for which purpose they travelled down the Elbe all the way from the Köhlbrand to the Köhlfleth.

The landing places provided for the ferry service comprise two recesses built at acute angles to the Köhlbrand banks. They have to guide the boats approaching them without coercion, as it were, until they reach the spot where the trucks can be transferred to the rail connections on shore. For this purpose they are of tapering shape towards the end. The guidance of the boats is effected, first by mooring posts, next by resilient wooden walls, and lastly by masonry shaped so as to conform to the shape of the boats. A slight difference in the levels of the shore and the boats is unavoidable although the carrying decks of the latter, as has been explained above, are adjustable. It is due to the different weight of the boats before and after taking up their cargoes of trucks. It has therefore been necessary to construct iron bascule bridges 49 feet long, to effect an adjustment. Moreover, it sometimes happens that one side of the boat carries a much heavier load than the other, so that a certain list must result. This has necessitated flexible connections between the main girders and the cross girders of the bridges to permit the latter to be tilted sideways. So long as the bridges do not rest on the boat, they are suspended, by means of a cross beam, from two winches that can be operated from the boat when landing in such a way as to adjust them to the correct level. Their own weight has been balanced by counterweights.

★

The Bridges.

Owing to the intricate nature of the network of traffic arteries that intersect the port, both ashore and on the water, the number of bridges is extremely large. It may seem strange that there should be so few movable bridges. The reason, as has been explained elsewhere, is the desire to obstruct traffic as little as possible, and this purpose could only be achieved by reducing to a minimum the number of bridges in places where shipping has a first claim to the right of way. Only ten, therefore, out of the 86 bridges in the harbour, are of the movable type. Why these were necessary, has also been explained in a preceding chapter (cf. page 39).

The fixed bridges, with the exception of the three Elbe bridges, possess no special features of their own. Their spans range between 36 feet and 270 feet. The movable bridges, on the other hand, are remarkable for a number of technical points connected with their design. The largest among them is the four-track bridge across Oberhafen built between 1902 and 1905. It has three fixed openings whose spans are 40, 80 and 90 feet respectively, and two movable openings each having a span of 77 feet. The girders are of the parallel girder type. The lower storey serves the needs of vehicular and passenger traffic, whereas the upper storey accommodates the four tracks of the railway line that joins Hamburg and Harburg. The width of the bridge is 53 feet. The movable part is designed as a symmetrical swing bridge, whose length is 155 feet. The drive is effected by hydraulic pressure.

East of this bridge there is a double-track railway bridge across Oberhafen-

Canal. It was opened to traffic in 1901 and connects the two railroad stations of Hamburg-H and Rothenburgsort. It crosses Oberhafen-Canal in a curve of 975 feet radius. It has five solid openings with spans of three times 88 feet, 108 feet, and 148 feet respectively, and two movable openings spanned by a symmetrical swing bridge 150 feet long. The bridges have semi-parabolic girders with the roadway below. Their drive is also effected by hydraulic pressure.

The Billhörner Brücke crosses the upper end of Oberhafen-Canal and forms the continuation of the road bridge across the Elbe. It had to be built obliquely across the canal, and its movable part is of the roller-bridge type. The length of the movable part is 156 feet, and that of the fixed part 188 feet. By moving the former part sideways at right angles to the centre line of the bridge for a distance of 91 feet, an open passage 48 feet wide is provided. Both parts have parabolic girders with the roadway below. They are 42 ft wide and serve the needs of the road traffic moving in the direction to and from the Elbe bridge. The drive is again effected by hydraulic pressure. The movable part runs on two rails arranged symmetrically to the middle of the bridge, so that more than half of the latter rests on land, where it is accommodated in a recess of the masonry. It was built in 1886.

The next two bridges, viz., Ericus-Brücke between Ericus-Graben and Brookthorhafen, and Meyerstrassen-Brücke between Brookthorhafen and Magdeburger Hafen, are very similar as regards their general design. They are approximately symmetrical swing bridges, the lengths of the two arms being 58 feet and 57 feet respectively. They are 29 feet wide and have plate girders with the roadway above. They serve the needs of road traffic. The swing mechanism is actuated by hand (Ericus) or by electricity (Meyerstrasse). They were built in 1869/71.

The only bridge crossing a harbour basin (Magdeburger Hafen) is Baakenbrücke. It is a symmetrical swing bridge and forms an acute angle with the longitudinal direction of the basin. Its movable centre part is 178 ft long, and the two adjoining fixed openings have a span of 54 ft each. Its width is 43 ft. It accommodates a railroad track and a roadway parallel to one another. The girders of the movable part are of the semi-parabolic type with the roadway below. Drive is effected by hydraulic pressure.

Of the two bridges across Reiherstieg the newer one is the most modern of all the movable bridges in the Port of Hamburg. It was built in 1906, and like the older bridge, which was opened to traffic in 1890, it has been provided with electric drive. It has two fixed and two movable openings, the spans of the former being 70 ft, and those of the latter 77 ft. It is 30 ft wide. It accommodates two railroad tracks, viz., the western arrival and departure tracks of the adjacent Hamburg-Süd station. It is the only railroad connection between the two sections of the port separated by the Reiherstieg. Whenever any repair work has to be done to it, it can be temporarily replaced by the older bridge, just as the functions of the latter as a road bridge can be taken over by the former in case of an emergency. The new bridge has been designed in such a way as to be usable for the purposes of the projected Port of Hamburg Elevated Railway, whose permanent way will rest on the top boom of the parallel girders. The older bridge is of the semi-parabolic type.

The small road and single-track railroad bridge (76 ft long and 59 ft wide) across the rear entrance to Segelschiffhafen has been designed as a one-sided lifting bridge in order to afford empty barges an unobstructed passage. The whole superstructure can be lifted about 6 ½ feet on one of the abutments. This is achieved by hydraulic pressure. The bridge was built in 1875/76.

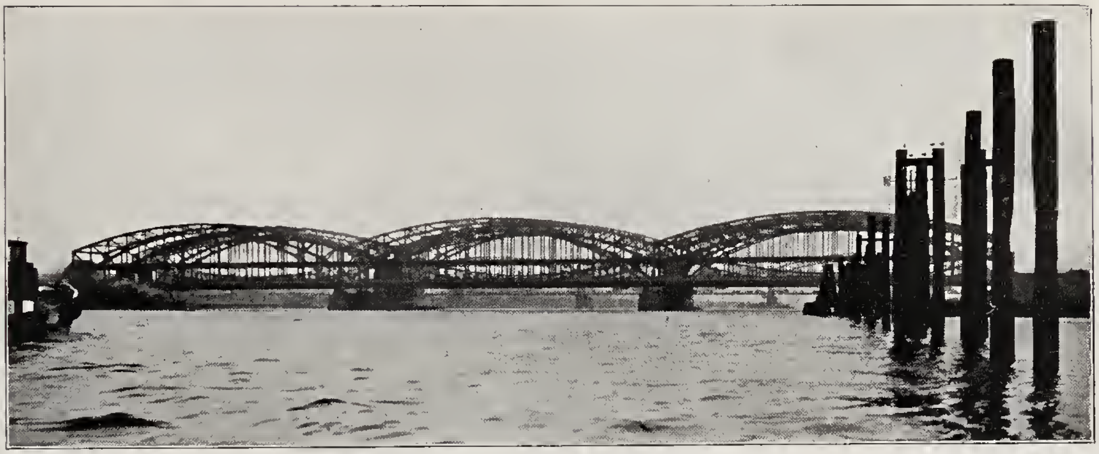


Fig. 45. The Bridges across the Elbe.

The tenth and last of the movable bridges, a wooden bascule bridge across the entrance to Fährcanal, is now obsolete. Its re-building, probably as a fixed bridge, is impending.

Among the fixed bridges the three built across the main Elbe (Fig. 45) deserve special mention because they are among the most noteworthy structures of their kind in Germany. Each of them has three openings about 330 feet wide, the width of the river in that neighbourhood being about 1,000 feet. Their construction took place at various periods. The oldest of the three, the railroad bridge inside the customs area, was built in 1868/72 and 1889/90; the next in order, viz., the road bridge crossing the river about 650 feet higher up and likewise situated within the customs area, in 1892, whereas the third — the one situated within the free port — was opened to traffic in the early part of 1926. Consequently, the difference in the design and type of the three bridges is very considerable, and corresponds to the progress made by engineering science in the course of half a century. The oldest of them was conspicuous, at least until quite recently, for its Lohse girders — a type which is not often met with nowadays and which, however picturesque and pleasing its effect may be to the eye owing to its beautiful curves, is looked upon with disfavour by modern science for being unremunerative and inadequate to present-day requirements. The same type of girders was employed in the design of the road bridge, because it was thought that, owing to the close vicinity of the two bridges, they ought to be alike in style. The National Railway Administration is now engaged in replacing part of the superstructure of the old bridge — which is no longer capable of meeting the demands of modern traffic — by a more up-to-date construction, of the same type as that of the third bridge, i. e., the one situated in the free harbour. The execution of this difficult piece of work has been entrusted to the firm of Messrs. Christoph & Unmack A.-G. After its completion the kind of girders selected for the latest of the three bridges, viz., double-hinged arches with horizontal tie member in the roadway (which is located below) will dominate the entire neighbourhood. As regards the Free Port bridge, its bottom boom is intersected by an upper roadway. The distance between the main girders is 55 ft, and the useful width 49 ft, two-thirds of which is used by road traffic, whereas the remaining one-third is occupied by the single railroad track. For the passenger traffic a bracket, 16 ¼ ft wide, has been provided. The upper roadway is intended to accommodate four lines of the track of the projected Port of Hamburg Elevated Railway. Massive portals, like those with which the two older bridges were provided in deference to the taste of the period, have been dispensed with, and the portals of the old bridge — which are only 39 ft distant from the third bridge — have been demolished. The three openings of the bridge required 6,580 tons of ingot steel and 276 tons of cast steel for the bearings. The work is being carried out by the firm of Messrs. Flender A.-G. für Eisen-, Brücken- und Schiffbau, of Benrath.

Generally speaking, the lowest line of the structure of all the bridges in the Port of Hamburg lies 15 ft above M. H. W., except that it is 3 ¼ ft higher in the case of the Elbe bridges. This enables barges and other small craft to pass safely through them at any state of the tide, except at those very rare periods of short duration when it is unusually high. A more elevated position would have entailed the construction of uneconomical and unsuitable approaches for the road and rail traffic.

★

The Elbe Tunnel.

The system of shore connections described in the preceding chapter is still further supplemented by the Elbe Tunnel (Figs. 46—49).

About the turn of the century, when the centre of the harbour area, owing to the constant addition of new basins, had commenced to shift more and more in a westerly direction, it became evident that the only provision hitherto made for a solid connection between the two river banks, viz., the Elbe bridges, was no longer adequate to meet the demands of the increasing traffic. The outcome of the prolonged discussions on the problem thus presented was the decision to augment existing facilities by the construction of a tunnel below the river bed. The rival projects of a viaduct and an aerial ferry were rejected. The tunnel as now built saves road vehicles — and, whenever the ferry-boat services have to be temporarily stopped in consequence of ice conditions or very dense fog, pedestrians as well — a détour of 7 ½ miles.

In view of the nearness of the city-built area to the northern, and that of industrial districts to the southern mouth of the tunnel, it was practically impossible to construct inclined approaches leading down to the level of the tunnel bed. Such an arrangement, moreover, would have involved long détours for the brisk direct traffic between the two opposite river banks. For these reasons it was necessary to provide a shaft at each end of the tunnel.

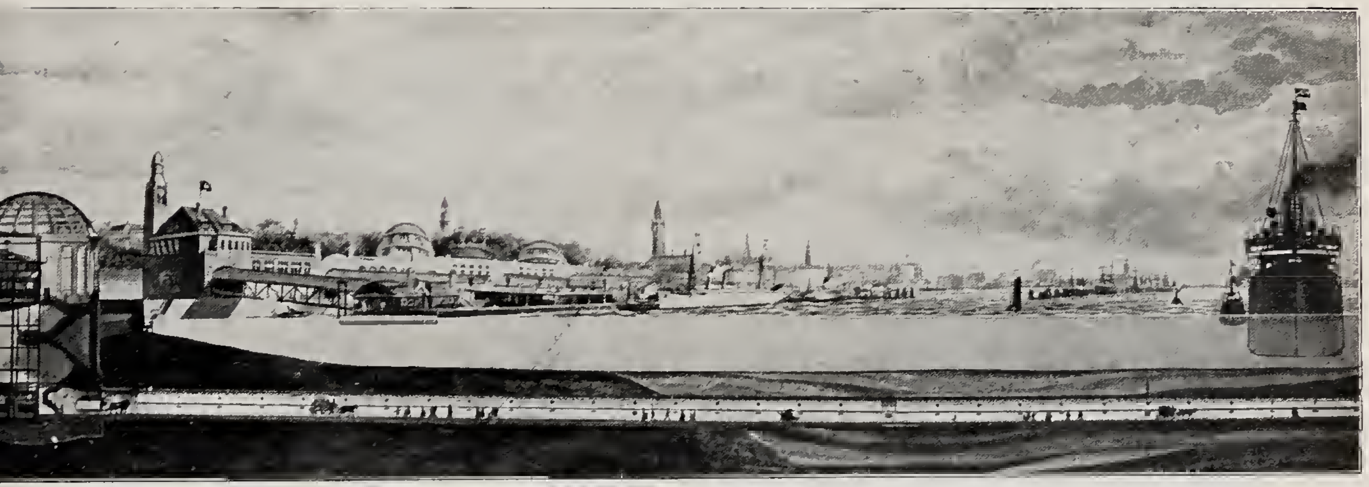


Fig. 46. Cross Section through one half of the Elbe Tunnel.

Each shaft has a diameter of 72 ft and a depth of 77 ft below street level. Each contains six electrically operated elevators whose lifting capacities are as follows: two of 10 tons, two of 6 tons, and two of 2.4 tons each. The four large elevators are used by vehicular traffic, and the other two by pedestrians. The walls of the shafts are provided with staircases. The elevators occupy half the area of each shaft, the other half being required to transfer the traffic from them to the subway. Above the road level the two shafts are surmounted by domed buildings whose large windows enable the daylight to reach the bottom of each shaft. Both are built entirely symmetrically, except that the choice of the material for the northern building was made with a view to the architectural style of the adjacent Landing Stages, whilst that used for the southern building was adapted to the character of the industrial neighbourhood on that side. The upper floor of each accommodates the driving plant for the elevators. As the tunnel leads from the customs area to the Free Port, special customhouse facilities had to be provided at the Steinwärder entrance.

The distance between the centres of the two shafts is 1,470 ft. They are connected by two separate subways, each serving the needs of one direction of traffic. The distance between the centres of the subways is 26 ft, and their outward diameter is 19 ½ ft. Their walls consist of rings made of 8-inch section iron riveted together, each ring being composed of six circular segments. They are surrounded by a layer of cement and packed with lead. The space available for the traffic in the subways has been suitably shaped by the provision of a concrete walling. Light and power cables, telegraph and telephone lines, pneumatic post tubes, and water piping are all accommodated in the side walls and in the bottom part of each subway. The remaining space is 15 ½ ft wide and 14 ¾ ft high. The two footpaths in each subway have a width of $4^3/_4$ ft each, and the roadway between them is 6 ft wide.

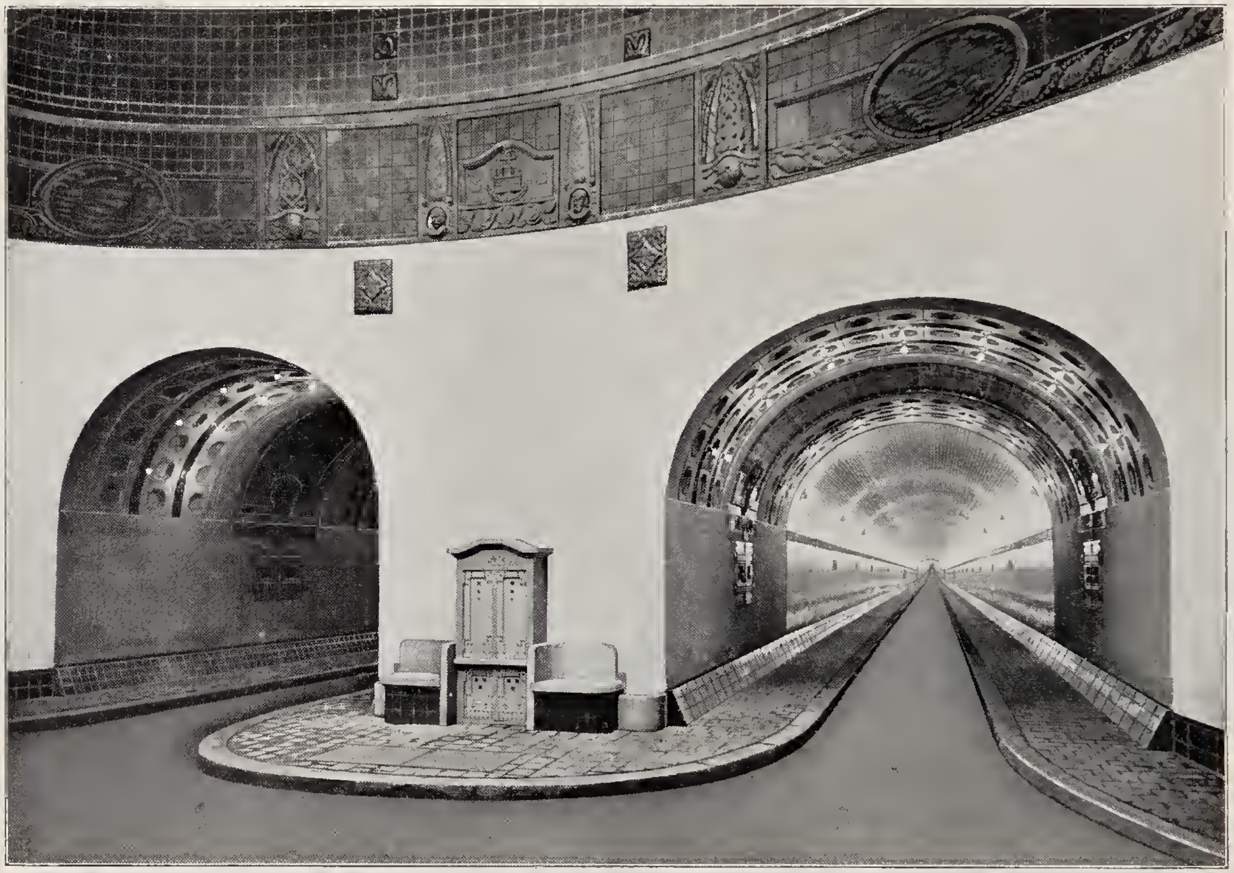


Fig. 47. The Elbe Tunnel: View of a Tunnel Tube from the Entrance.

Each subway consists of two terminal sections and one middle section. The former have a gradient of 1:100, whilst the latter is horizontal and has a length of 355 ft. The lower edge of each subway lies 72 ft (the roadway 69 ft) below M. H. W. and 77 ft below road level. The thickness of the layer of soil between the river bed and the top edge of the subways is 18 ft, but the depth of the river can be safely increased by another 8 ft (providing a total depth of 42 ½ ft below M. H. W.) without impairing in any way the safety of the tunnel.

As the weight of the tunnel construction is less than that of water, it follows that the subways would possess a considerable buoyancy and would be liable to deflection unless provision were made for additional load. This was done through an increase in the weight of each yard run by the addition of 1.85 tons of pig iron, so that the specific gravity of the whole construction is now 1.01. Consequently, the subways are held approximately balanced, except that they exert a slight pressure on the ground below.

The shafts and subways are faced with glazed earthenware slabs and decorated with sculptural ornaments. The whole of the interior of the tunnel is brightly illuminated by means of incandescent light.

It goes without saying that every possible precaution has been taken to ensure the absolute safety of the working of the tunnel. As a matter of fact, no dislocation or accident has taken place in it during the whole of the sixteen years it has been in use.

The improvements aimed at by building the tunnel have been completely realised. When pedestrian traffic

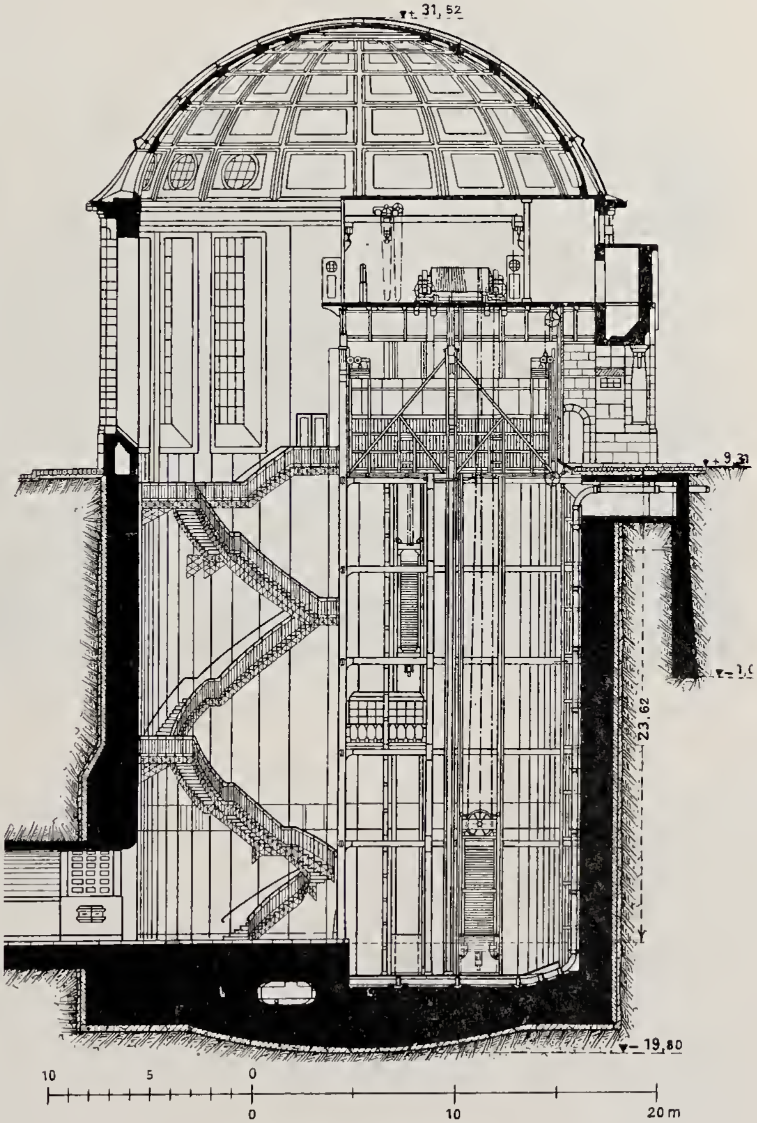


Fig. 48. The Elbe Tunnel: Longitudinal Section through a Tunnel Shaft.

is very heavy, the tunnel is closed for vehicular traffic. Five hundred persons can then be carried by the six elevators simultaneously (Fig.49). At certain times — when the ferry-boat services have to be temporarily stopped on account of ice or dense fog — more than 70,000 persons a day can make use of the tunnel. A motor car only requires two or three minutes to pass through the tunnel.

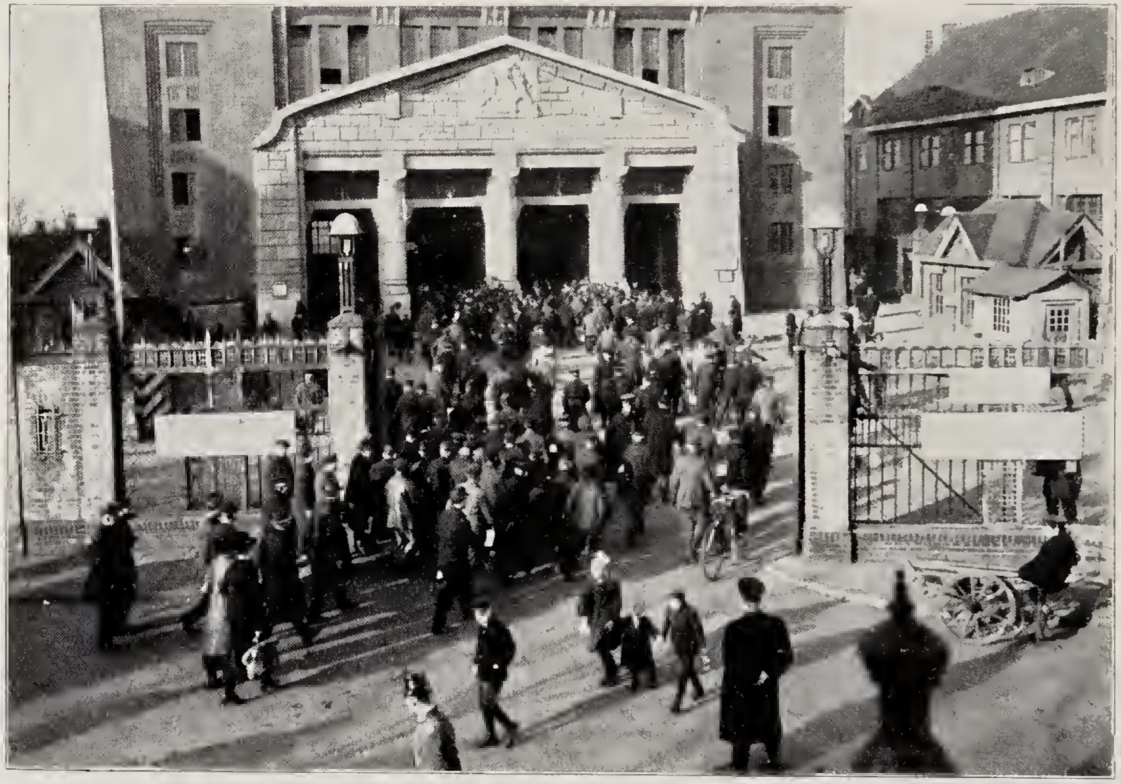


Fig. 49. The Steinwärder Entrance to the Elbe Tunnel.

The tunnel was built by Messrs. Philipp Holzmann & Cie., of Frankfort-on-Main, in accordance with the designs of the *Wasserbaudirektion* (Board of Hydraulic Engineering) and subject to its supervision. Work on it was started on July 22nd 1907, and the completed tunnel was opened to traffic on November 30th 1911. The expenditure spent on its construction amounted to 10.7 million marks. Pedestrians use it free of charge, whilst vehicles have to pay a small fee according to a fixed scale of charges.

The Elbe Tunnel being an engineering achievement of more than ordinary interest, a few brief data concerning its construction may perhaps be welcome. The ground where tunnelling had to start on the St. Pauli side consists of solid clay with a layer of sandy marl on top of it. The layer of clay is impermeable to water. Towards the middle of the river, however, it slopes abruptly downward, and there, as well as on the Steinwärder side, it is covered by beds of loose sand and gravel, which present practically no obstacle to the passage of water. It follows that the preliminary conditions under which the work had to be carried out were entirely different at the two ends of the projected tunnel. The clay on the St. Pauli side could be worked in a comparatively simple manner by open cut and with the aid of drainage, but the construction of the Steinwärder shaft and the subways necessitated the use of compressed air.

Before the St. Pauli shaft could be built, an annular concrete cofferdam had to be constructed in order to collect the water contents of the marl. Within it, a hole $8\,^1/_4$ ft wide and likewise shaped like a ring was dug to the depth of the shaft bottom, and the cylindrical shaft wall was built inside, starting from below. When this was completed, the central core of soil was removed, and the shaft bottom in the shape of an inverted vault was built-in.

Much more difficult was the construction of the Steinwärder shaft. Its walling consists of reinforced concrete encased by sheet iron lining. This enormous massive cylinder was sunk, with the aid of compressed-air methods, into the working space below, which was 33 ½ ft high, the construction of the reinforced concrete body coinciding, in its various phases, with the sinking of the shaft. The top part of the working space, after the subsoil-water bearing stratum had been reached, was closed in by a very strong caisson ceiling, so that it floated in the soil like a bell resting on the compressed air which, at the same time had to prevent the water pressing from below from entering the working space. In proportion as the soil in the working space (access to which was effected by air locks) was excavated and conveyed upward by the locks, the shaft, vertically guided in a wooden framework, kept sinking until it had reached the required level. Then the bottom was built-in in the same way as that of the other shaft.

Next, the two tubes for the subways were driven forward underneath the river bed, starting from the Steinwärder shaft and working in the direction of the St. Pauli side. For this work, too, compressed air was used. A cylindrical shield, made to encase the part of the tunnel wall already completed, was forced by hydraulic pressure to move forward in the direction of the former in proportion as the soil was excavated in front of it. In this way the work progressed at the rate of about five feet a day. Two additional rings were always added after each advance of the shield. The compressed air which there, too, had to prevent the water from entering the working space, was at first kept out by the caisson ceiling of the shaft, and afterwards by solid partitions inserted in the tube. The partitions contained the air locks for the material and the workmen.

When the two tubes had reached the St. Pauli shaft, its wall was pierced, and the tunnel was completed in the usual way after first blowing out the compressed air.

★

The preceding description of technical details includes accounts of all those facilities that are of essential importance to the work carried on in the Port of Hamburg in connection with the transhipment and handling of goods and the needs of traffic. A separate section will now be devoted to the historical development of the port.

SECTION FOUR.

The Historical Development of the Port of Hamburg.

I.

From the Earliest Times to the Completion of the First Quay (1866).

We are so used to thinking of Hamburg in terms of trade and shipping that we find it difficult to realise that this close association has not always existed. The city does not even owe her origin to the demands of these two branches of human enterprise, but rather to the desire of the ancient North Albingian tribes for the possession of a fortified place to protect them against hostile incursions. The site between the courses of the Rivers Elbe, Alster, and Bille was eminenty suited for this purpose owing to the difficulty of access to it. The first historical mention of Hamburg occurs in connection with the campaigns of the Emperor Charlemagne whose armies crossed the Elbe A. D. 804, and took possession of the castle. By him Hamburg was incorporated with the Frankish dominions, and she soon became a place of some importance, more especially so after she had been made an archiepiscopal see in the reign of Louis the Pious, the successor of Charlemagne (831). It was not only ecclesiastically, but also politically, that she made considerable progress in those early years, and she soon became a centre for the trade with the Northern countries. A small city, the present Altstadt, grew up round the castle. Her commercial interests were originally confined to trade with the north and east, whereas the maritime commerce of the

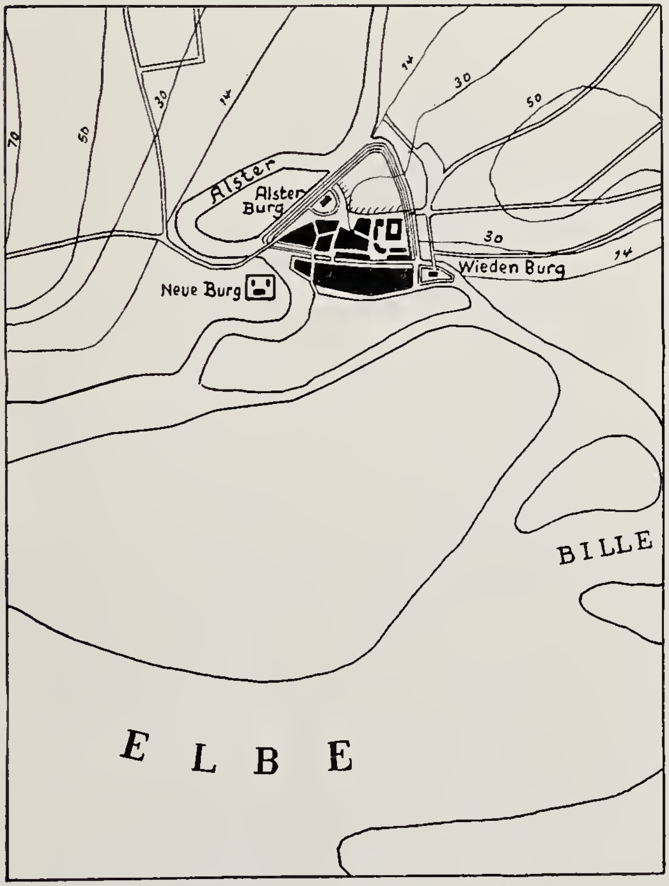


Fig. 50. Hamburg about 1100.

hinterland was monopolised by Bardowiek — now an unimportant country town near Lüneburg on the River Ilmenau — and by Stade, a town situated in the district lower down the Elbe.

Politically Hamburg, in those days, was subject to the authority of the dukes of Saxony who were entrusted by the emperors with the task of protecting these regions. They built a second castle, the "Neue Burg" on a site west of the original one (Fig. 50), to be their residence. Somewhat later Hamburg is referred to as part of a county embracing the districts of Holstein and Stormarn and subordinate to the dukes of Saxony. The counts of Schauenburg, who were invested with this county in 1111, have exercised a decisive influence on the history of the city, and it was during their rule that Hamburg first became important as a port. This was due to the foundation, by one of the Schauenburg counts, of the city and port of Lübeck (1143) on the Baltic, which necessitated the existence of a North Sea port working in close cooperation with it. Thus a new city, in no way connected with the older settlement, sprang up near the mouth of the Alster and around the "Neue Burg". Both cities, the original one centring round St. Peter's Church, and the later one centring round St. Nicholas' Church, were entirely separate administrative units for a long time after their foundation. In 1189 the then count of Schauenburg secured from the Emperor Frederick Barbarossa a charter for the "new city" of Hamburg, by which, in addition to other privileges, she was granted complete exemption from the payment of customs duties on the Lower Elbe. Simultaneously with these rights Hamburg also took upon herself the duty of regulating the course of the river for the purposes of shipping — a duty which she conscientiously carried out for nearly seven and a half centuries, viz., until April 1, 1921, when it was taken over by the national government. At the same time Hamburg's hold on the maritime trade increased owing to the destruction of Bardowiek, her most successful rival until then. Gradually the two Hamburgs succeeded in freeing themselves from the jurisdiction of the justiciaries appointed by their feudal overlords and in introducing a system of local self-government by popularly elected councils. The consolidation of their power resulting from such action was a great help to them in their struggles against Denmark which, early in the thirteenth century, made several attempts to obtain possession of Hamburg whose future importance the Danish kings did not fail to foresee. For a time these attempts were crowned with success, and the two Hamburgs were incorporated with Denmark. Their joint misfortune, however, linked them together more closely than before, and in 1216 they were merged into one single corporate unit. But even this union of forces was not sufficient to guard them completely against the designs of their powerful neighbour, and although Hamburg regained her freedom after the celebrated battle of Bornhöved (1227), her relations with Denmark continued unsettled and ill-defined until after the time of the Napoleonic wars. Her position was made particularly difficult owing to the want of a strong central authority in the old Germanic Empire of which she was a member, but it must be borne in mind that she could not have attained her powerful position as a commercial emporium without the high degree of independence she actually enjoyed.

The government of the city became more and more the privilege of her merchant aristocracy. From being a mere transit harbour she gradually grew into a port with a trade of her own, and the extent of her hinterland became more and more clearly defined. Even then it included the Elbe country right up to Bohemia together with the Havel and Spree districts. Close maritime associations were established with England, Holland, and Norway. Thanks to numerous foreign privileges acquired by Hamburg and Lübeck, the ancient highroad between the two cities developed into a purely German trade route extending from Bruges to Russia, and these preliminaries to a much greater future development were still further supplemented by the growth of several local industries carried on with a view to export. It was the Hamburg-brewed ales and stouts that made the city one of the premier exporting centres about the close of the thirteenth century, and it was her exports of these commodities to which she owed a great many of her overseas trading connections, although these latter were subsequently augmented through different channels.

During this period of commercial expansion Hamburg also made considerable progress in divesting herself of the ties that bound her to the secular power of the counts of Schauenburg and to the ecclesiastical authority exercised by the cathedral chapter, whilst the aristocratic City Council hat to delegate some of its powers to the regular meetings held by the property-owning burgesses, so that the foundation was laid for the city's future constitution based on the principle of dual government.

The rise of Hamburg as an independent commercial emporium is closely connected with the growing power of the Hanseatic League, the famous association of numerous commercial cities, in whose councils Hamburg played a leading part, although the recognised head of the League was Lübeck.

During the fourteenth century — a period of great importance to the development of the city — she also commenced to systematically extend the frontiers of the territory owned by her. She acquired numerous districts that proved invaluable to her in subsequent centuries, including Billwärder, Ochsenwärder, Moorwärder, the Vierlande district, and Moorburg. These various acquisitions gave her control of large parts of the River Elbe. The same policy of territorial expansion was applied to the district near the mouth of the Elbe, in doing which the city was actively assisted by Emperors and Popes who granted her some valuable privileges against the pirates. As early as 1309 she had caused a strong tower to be built on the island of Neuwerk which she supplied with a permanent garrison. In 1394 she also acquired the bailiwick of Ritzebüttel, i. e., the district facing the island just named, and now containing the important outport of Cuxhaven.

The territorial policy thus inaugurated was continued during the fifteenth century, always with a view to enlarging the city's maritime power. It was even applied to districts situated a long way distant from Hamburg. Thus, in 1432, the city of Emden and a large slice of Ostfriesland (Eastern Frisia), were acquired, and these territories were in the possession of Hamburg for twenty years. Her population at that time was about 10,000, and as a political factor she wielded a power only comparable with the commercial ascendancy she gained at a much later date. In the consciousness of her strength she strictly enforced her entrepôt monopoly on the Elbe, by doing which she greatly consolidated the natural advantages due to her geographical position and eliminated all possible rivals. By the uncompromising exercise of her police rights on the Lower Elbe she compelled the entire grain trade of the district to pass through Hamburg, so that she became the most important grain-exporting centre, especially in the trade with the Netherlands. Emperors and Popes could not prevent the powerful city from acting as she did, and had to confirm her trading monopoly.

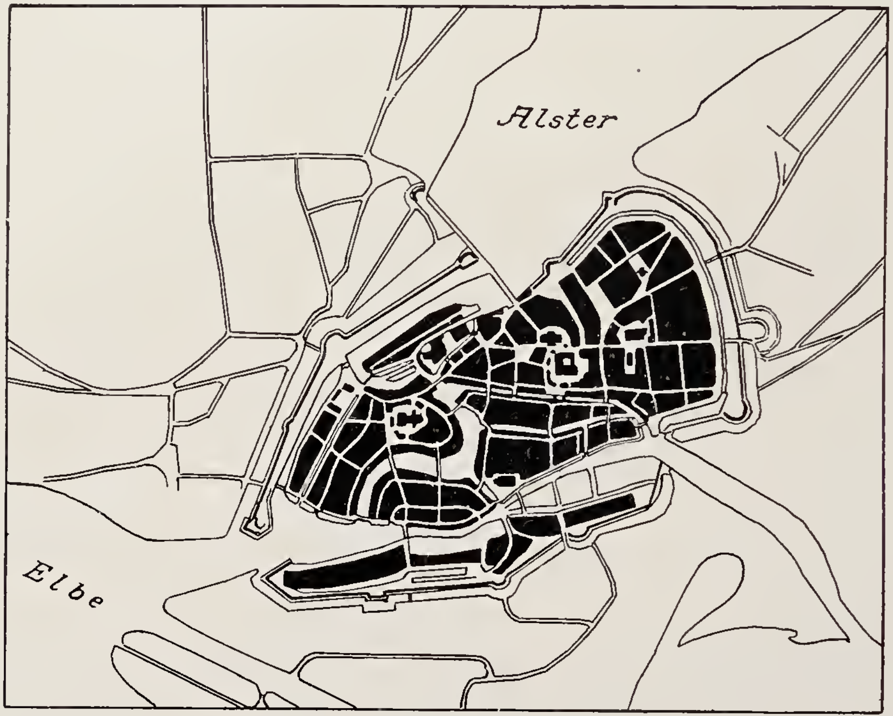
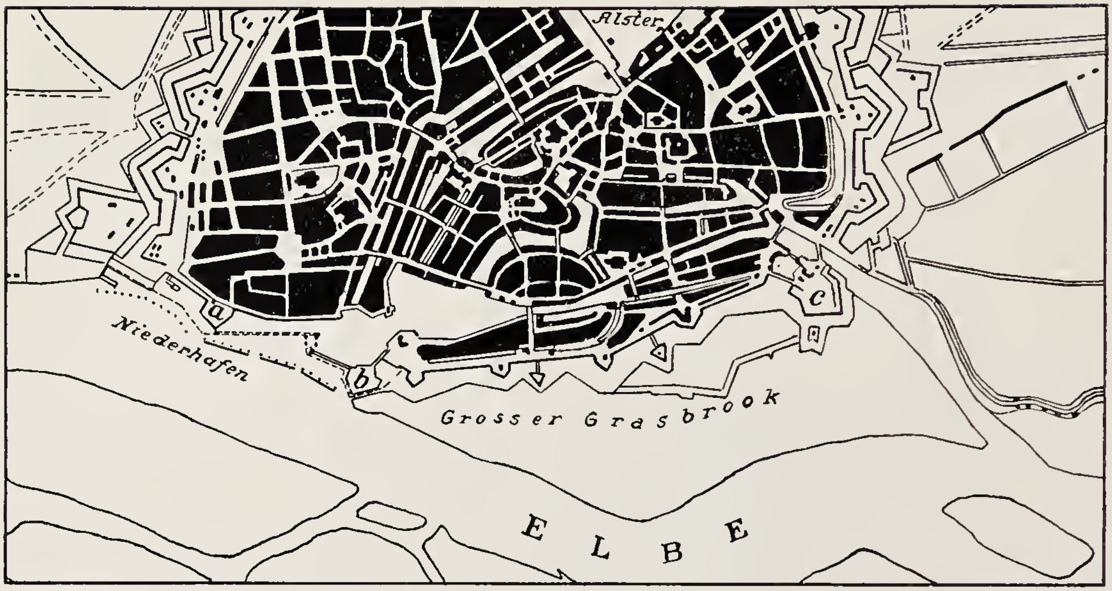


Fig. 51. Hamburg about 1400.

Shipping, too, continued to be a prospering industry. To the older corporations of England, Flanders, and Skane traders there was added, in 1470, the guild of Iceland traders. For a time, however, the growth of trade and shipping received a setback caused by new conflicts with Denmark, by disputes with the Empire on the question of the status of Hamburg as a free city, by the religious struggles of the Reformation period, and by civic dissensions. It was only during the second half of the sixteenth century that the city's shipping activities started upon a new era of expansion. The policy pursued was to open up direct trading intercourse with the French, Portuguese, and Spanish seaports and to promote the growth of local industries. The first bourse or exchange on German soil was established in Hamburg in 1588. The first systematic endeavours to improve the harbour (at that time still formed by part of the River Alster) and the open roadstead just outside it belong to the same period, and a special board, the so-called *Düpebehörde*, was entrusted with this work. With the progressing decline of the Hanseatic League Hamburg dissociated herself from this body, and began to develop into an international commercial centre. The commencement of this development dates from the admission to Hamburg of the English Merchant Adventurers after their expulsion from Antwerp. They were granted some considerable privileges and possessed the monopoly of dealings in English-made cloth. This event naturally linked English shipping to the port of Hamburg more intimately than ever before. The English immigrants were soon followed by others from Holland, Spain, Portugal, Italy, France, and all parts of Germany, whose varied trade connections were utilised for the benefit of the growing city. The sphere of her commercial interests expanded in all directions. Her merchants opened up branches of their firms in the Spanish and Portuguese seaports, and these in their turn enabled the Hamburg shipping trade to get a foothold in the Mediterranean and in the Spanish and Portuguese colonies in Africa and South America. In 1619 the Hamburg Bank — an institution which soon acquired a high reputation throughout the world — was founded, and in 1665 the first German chamber of commerce, at that time known as the *Commerzdeputation*. The importation of new commodities led to the rise of new industries, and it was in those days that Hamburg, after her ale and stout had lost their importance as export articles, laid the foundation of her numerous refining industries.

By the early years of the seventeenth century the River Elbe, as has been explained elsewhere, had been regulated, through the untiring efforts of the Hamburg authorities, to such an extent that ships of the size usual in those days could safely navigate it right up to the harbour. This shews that Hamburg clearly recognised how necessary it was to utilise to best advantage her geographical situation if she meant to maintain intact her commercial supremacy.

Not even the troublesome times of the Thirty Years' War could prevent her from making headway in this direction. She remained strictly neutral during this great international struggle, and defended her neutrality by surrounding herself with a new and enlarged system of fortifications (Fig. 52). Its site can still be traced in the modern plans of the city, their place having been taken by the circular road separating the mediæval city from the more modern districts. The harbour, too, was included within the system and was protected by some of the strongest bastions. These powerful ramparts were built from 1616 to 1625 by a Dutch expert in fortification work, and the parts



a. Johannisbollwerk b. Hölzern Wambs c. Ericus

Fig. 52. Hamburg about 1700.

located in the harbour area were not demolished until the middle of the past century when they had to give way to the needs of shipping.

The chief opponent Hamburg had to face at that time in regard to her claim to dominate the Lower Elbe was, as usual, Denmark. The Danes endeavoured, by founding the new city of Glückstadt, to provide a rival to Hamburg, and hoped that their military occupation of Stade and Altona would enable them to secure for themselves the Elbe tolls and the control of the Elbe shipping. These hopes, however, were doomed to failure. The very opposite happened: Hamburg, in 1628, was granted an Imperial Charter which conferred on her valuable privileges concerning the Lower Elbe, and when, in 1645, the war was drawing to its close, Christian IV of Denmark had to sign an agreement in which he explicitly acknowledged the ancient rights of Hamburg to the river. Since then these rights have never been seriously questioned again. They were more strictly defined by several agreements arrived at, between 1868 and 1908, by Hamburg and Prussia, and were transferred to the central government in 1921.

Up to the end of the Thirty Years' War the policy pursued by Hamburg was mainly supported by foreign powers, such as Great Britain, Holland, and — above all — Sweden, with the result that these nations became very materially interested in the prosperity of the trade emporium on the Elbe. Subsequently, however, Hamburg found a powerful and capable supporter in Germany herself, viz., Frederick Wilhelm of Brandenburg, popularly named the Great Elector. His great gifts as a ruler enabled him to see clearly how close a connection there was between the interests of the big German seaport and those of his own dominions, especially those of the newly acquired district on both sides of the Elbe with Magdeburg for their centre. Hamburg is indebted to him for the building of the Müllrose-Kanal (opened to traffic in 1669) by which her hinterland was enlarged towards the east and made to extend as far as the Oder district. In this way Hamburg became the maritime outlet of the Silesian, Polish, and Brandenburg trade, the mouth of the Oder being silted and blockaded. The energetic intervention of the Elector also strengthened the position of Hamburg in her disputes with Denmark. The thoroughly disorganised financial condition of that country even caused her, between 1650 and 1652, to approach Hamburg with requests for financial assistance in the shape of a big loan against which she was prepared to cede the districts of Pinneberg, Ottensen, and Altona, and the Elbe islands between Kaltehofe and Dradenau, but Hamburg, owing to the shortsighted views of rival groups at home, declined these offers. After that the relations with Denmark became strained again, and the Danes, after raising Altona (1664) to the rank of a city, hoped to make it a serious rival to Hamburg. Warlike operations were started once more, Hamburg was besieged by the Danes in 1686, and a battle took place which, mainly through the intervention of the Great Elector, was decided in favour of Hamburg.

Those events clearly shewed that the Hanseatic League, to all intents and purposes, had ceased to exist, because Hamburg had received no aid from it. In spirit and name, however, the tradition of that great organisation has been kept alive by Hamburg, Lübeck, and Bremen, even though no formal ties link them together any longer. Towards the close of the seventeenth century Hamburg had to rely more than ever before on her own unaided strength. In order to accord protection to the two hundred merchantmen then owned by her citizens she built several war vessels that convoyed them on their passages across the high seas and that subsequently took place in a number of victorious engagements. Thus the foundation of a navy was actually laid, and the whole was placed under a board known as the Admiralty. Advantageous commercial treaties were concluded with the countries of Western Europe, and the range of the city's shipping interests was enlarged still further. A new route, the Greenland route, was much patronised by Hamburg traders, and the local industries largely benefited from the whale and seal fishery in which they engaged.

The external history of the city began to take a somewhat less eventful course about the close of the seventeenth century, and this condition continued until it was disturbed by the troubles caused by the Napoleonic wars.

If we now ask ourselves, "What sort of a harbour was it that Hamburg possessed in the early part ot the eighteenth century?" we cannot do better than consult the maps of to-day, where we can distinctly trace its size and shape about the time of transition from the middle ages to our modern era. The city's first harbour consisted of nothing but the wide S-shaped Nikolaifleth (Fig. 8), which was originally the lower course of the Alster, together with the narrow canals (*Fleete*) branching off from it. This watercourse is still crowded with numerous small vessels and its banks are still lined with warehouses, so that it enables us to obtain a good idea of the mediæval harbour. Gradually the provision for ships' berths was extended to the southern edge of the city and to the outer roadstead opposite the mouth of the Alster, which, on the whole, corresponds to the present Inner Harbour or Binnenhafen (Fig. 67). This part only became an "inner" harbour during the fifteenth century when part of the land and water area south of the city was enclosed within the line of fortifications then constructed, the entrance to the basin thus formed being closed by the so-called *Niederbaum* (the lower boom), a floating boom placed between two groups of piles and serving to block the entrance after traffic hours. Its situation very nearly corresponds with that of the present Niederbaumbrücke (Fig. 59) at the western extremity of the Binnenhafen. From there the line of ramparts extended along the southern edge of the city where it was protected by a cut practically corres-

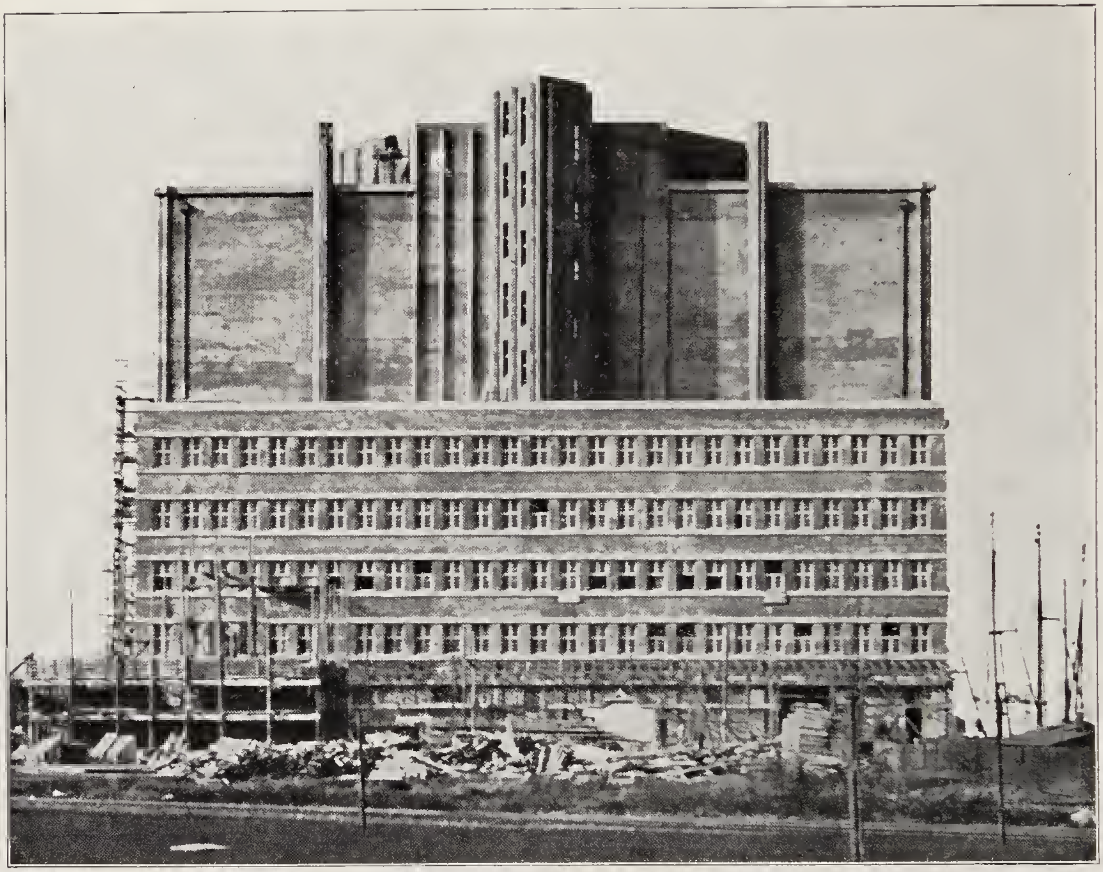


Fig. 53. Cold-Storage Warehouse on Rosskai.

ponding with the present Zollcanal. This ancient cut, which was navigable for barge traffic, had been extended in an easterly direction up to the mouth of the River Bille as early as 1258, and linked up up-river traffic with the Binnen-Hafen where the sea-going vessels were berthed. In later times it served to connect the Oberhafen or Upper Harbour (near the eastern edge of the city) and the Niederhafen or Lower Harbour, i. e., the roadstead *outside* the Binnenhafen which began to be used by ships after the provision available in the latter basin had proved no longer sufficient.

The names Niederhafen and Oberhafen have been retained until the present day. For centuries the basin described by the former constituted the principal part of the Port of Hamburg. Its adaptation to the growing traffic needs was the main object of all harbour improvement schemes up to the nineteenth century. The ramparts constructed during the Thirty Years' War gave it its definite size and shape. Its western limit was the bastion called Johannisbollwerk, which projected far into the main river, and whose name is still preserved in that of the modern shore road. Its eastern end was the Hölzern Wambs bastion, an advanced work likewise projecting far into the river, but from the western extremity of the Grasbrook island. Two rows of palisades extending from one to the other bastion separated the Niederhafen from the river, except for the double entrance midway between them, which could be closed by the new Niederbaum, a floating boom consisting of two parts. The older Niederbaum above referred to, between Baumwall and Kehrwiederspitze, was done away with. A blockhouse built into the water and connected with the Hölzern Wambs by the Neptunsbrücke protected the harbour entrance. It was also used for collecting the excise.

A narrow strip of the Grosser Grasbrook, the spacious island just south of the city, was included with the system of fortifications built during the Thirty Years' War, and was separated from the remainder of the island by a non-navigable watercourse provided with locks. Thus the Kehrwieder-Wandrahm island, now occupied by the warehouses of the Freihafen-Lagerhaus-Gesellschaft and the Sandthorquai pier sheds, etc., (Fig. 74) was formed between the old and the new ramparts. The watercourse just described became, at a much later period, the nucleus of the present Sandthorhafen. Its eastern entrance, at the Oberhafen end, was protected by another powerful advanced work, the Bastion Ericus, whose pentagonal ground plan is still recognisable in the 1865 harbour map (cf. the Historical Map No. VI), and whose name has been kept alive in that of the present Ericusgraben.

For about a century, i. e., until the middle of the eighteenth century, the Niederhafen, as just described, was found sufficient for the needs of shipping. In course of time, however, the water space available within the Niederbaum became inadequate, the vessels frequenting it gradually increasing in size and in numbers. Once more part of the open river had to be added to the harbour and to be protected in the usual way. In 1767 Ernst Georg Sonnin, who had built St. Michael's Church (Fig. 77) and who was a recognised authority on hydraulic engineering as well, submitted a scheme for the extension of the Niederhafen. It provided for the construction of a row of dolphins about 1,800 feet long with floating booms outside, and for increasing the depth of the part thus separated from the main stream. The dolphins were also to be used by the sea-going vessels for making fast. The ends of the row of dolphins were located in front of the two harbour bastions. The water within the area thus enclosed was comparatively calm. The scheme was adopted, and in 1795 a second row of dolphins was added still further outside. It was nearly twice as long as the earlier one, and extended in a westerly direction beyond Johannisbollwerk as far as the Bastion Jonas. The latter was situated at the foot of the rising ground now occupied by the Deutsche Seewarte (Fig. 54) and the Navigationsschule, but in those days also protected by strong fortifications, viz., the socalled Hornwerk and the Bastion Albertus. The outer Niederhafen was about 3,300 feet long and, on an average, about 400 feet wide. At that time the two names Rummelhafen and Jonashafen sprang up to describe the eastern and western portions respectively into which the whole basin was divided by the Johannisbollwerk.

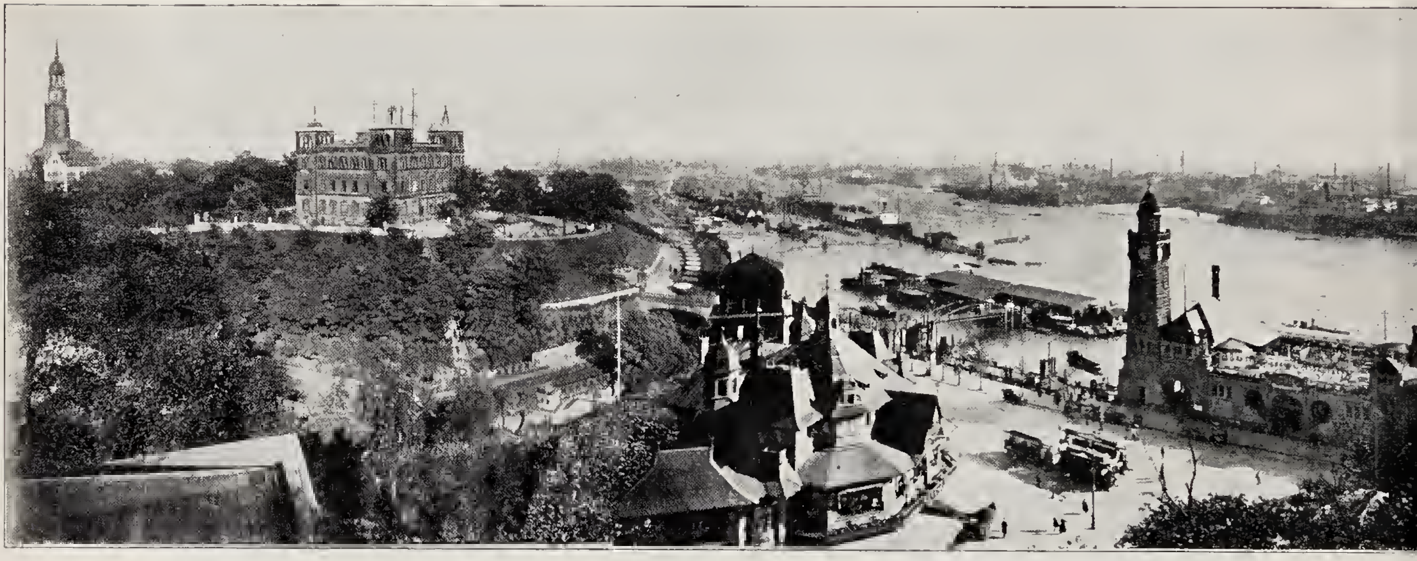


Fig. 54. View of the Main Elbe near St. Pauli Landing Stages. The Nautical Observatory on the left.

Such was the condition of the harbour during the next fifty years or so. Loading and discharging operations were conducted in such a way that the large sea-going vessels were handled outside the Niederbaum where they were either lying at anchor or made fast to the two rows of dolphins, whereas the smaller ships passed through the entrance that led to the inner Niederhafen and the Binnenhafen, and there took up their berths. The vessels had no contact with the shore in any way. This was impossible, apart from other reasons, because of the strict municipal excise regulations. Quay facilities in any way similar to those now available were entirely wanting. The cargo to be discharged was transferred to small harbourcraft *(Prähme)* by which it was conveyed ashore and to the warehouses of the merchants. The consignments for exportation were taken aboard in the same way. At that time, therefore, and right up to the 'sixties of the past century, the only method of transhipment employed was what is now called "midstream" transhipment.

The increasing use made of the main river for harbour purposes just described naturally suggested the desirability of making use of the full width of the river, whose hydrological conditions were bound to be affected by the extension of the harbour. Unfortunately, the opposite bank — which seemed very suitable for industrial sites — belonged to Denmark. Its acquisition by Hamburg, however, was facilitated by the renewed financial troubles of that country, and a treaty, the Treaty of Gottorp, was concluded on May 27, 1768, largely through the intermediary of the Duke of Holstein-Gottorp, by which Denmark, in return for valuable financial assistance on the part of Hamburg, ceded to the latter the islands and districts on the left bank of the Elbe, viz., Kaltehofe, Peute, Müggenburg, Veddel, Schuhmacherwärder, Steinwärder, Grevenhof, Kuhwärder, Ellerholz, Maakenwärder, Mühlenwärder, Griesenwärder, Park, Pagensand, Flethsand, Dradenau, and part of Finkenwärder (cf. the Historical Map No. VI). The sum paid by Hamburg was so considerable that it took several decades before the Treasury could recover from the sacrifice then made. But the transaction certainly paid the city in the end. Even though one item of the far-seeing and eminently practical programme elaborated by the *Commerzdeputation* (Chamber of Commerce), i. e., the acquisition of Heligoland, had to be abandoned, the treaty nevertheless gave Hamburg the foundation on which she could develop into a port of international importance. It was not until a century and a half later — when practically the whole area acquired by the treaty had been utilised for harbour purposes — that Hamburg found it necessary to approach her neighbour (Prussia) once more with a view to an extension of her boundaries. How great the foresight of the men of 1768 really was can be best judged by comparing the large extent of the acquisitions obtained under the treaty with the small size of the harbour area at that time.

The Treaty of Gottorp, however, was also of great importance in another respect. It led, again through the intermediary of Holstein, to an agreement between Hamburg and the Emperor that confirmed the status of the former as a free city of the Empire with full sovereign rights. For more than two hundred years had she endeavoured to have this matter settled, but Denmark had persistently prevented it.

The trade connections of the new city state underwent a welcome extension during the following period. This development was hastened by political events, such as the American War of Independence in consequence of which, from 1780 onwards, the United States and the West Indies were thrown open to the Hamburg trading firms because of the neutrality maintained by their city, and the revolutionary disorders in France through which shipping was deviated from French ports to Hamburg. After the French conquest of the Netherlands in 1795 the Dutch shipping trade was similarly deviated to Hamburg. The Eider Canal, constructed at that time by Denmark, gave Hamburg a valuable connection with the countries of North Eastern Europe. About 1800 there was no Continental city that could rival Hamburg as a centre of international traffic.

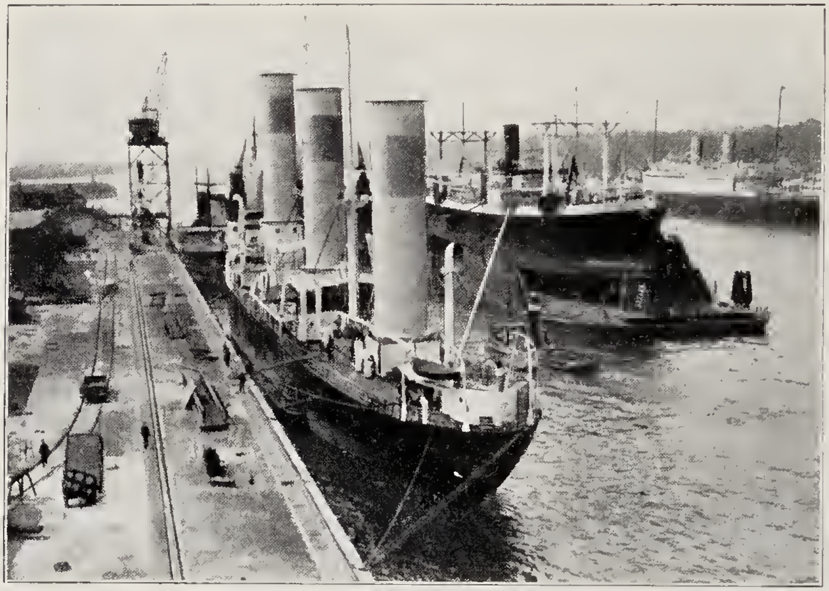


Fig. 55. A Flettner Rotor Ship.

The further enlargement of the harbour, however, was delayed for a considerable time owing to the rise of a new problem facing the authorities. In 1791 and 1792 the low-lying districts of the city were twice inundated, and an immense damage was done to dwelling houses and warehouses. That, of course, was not the first time that such catastrophes had visited the city, but the destruction wrought had never been so considerable. Several schemes were prepared by which provision was to be made to prevent the recurrence of similar, disasters, the most important among them being that submitted by Professor Büsch in 1793. Büsch enjoyed a high reputation both as a naturalist and as a political economist. His suggestion was that the two openings in the rampart by which the high water could enter the Niederhafen and the Oberhafen should be dammed up and be replaced by locks that were to be closed when an exceptionally high tide was expected, and were to be open at other times. This proposition, therefore, had nothing in common with those later projects for a dock harbour which provided that the locks should normally be closed and should be opened for the passage of vessels only when the levels of the water within and without were about equal. It is nevertheless easily comprehensible that the proposed restrictions of harbour traffic were distasteful to the trading and shipping community. The modification of Professor Büsch's project, in its technical aspects, by Reinhold Woltmann, the subsequent Director of Hydraulic Engineering *(Wasserbaudirektor)*, likewise failed to find general acceptance. The harbour had never before been the object of so much public discussion, and the interest taken in it was by no means merely local. For a long time the Büsch-Woltmann project occupied an important position in connection with the harbour improvement schemes subsequently prepared, because its leading idea, i. e. , the protection against exceptionally high tides, was too valuable to be ignored altogether. It was not until after the Great Fire of 1842 that it was finally dropped, and that a different solution of the problem presented itself, viz., by levelling-up of the parts destroyed by the fire in so far as they were exposed to the danger of inundations.

All harbour improvement schemes, however, and, indeed, all trading and shipping intercourse with other ports, came to a sudden stop in November 1806 when Hamburg was occupied by Napoleon. This step was really directed against Great Britain, because Napoleon took the view, and rightly so, that Hamburg was one of the main centres of Britain's foreign trade. The Continental System, a further step in the same direction, eliminated Hamburg as a trading emporium for years, and the years from 1806 to 1815 are represented by a blank page in the history of the Port of Hamburg. Even after the hour of deliverance — which, as far as Hamburg was concerned, struck in May 1814 — the prospects of re-building the lost merchant fleet, of re-opening the former business connections, and of re-starting the local industries were almost hopeless.

Soon, however, several changes took place in the economic relations of various nations which could not but favourably affect the work of reconstruction taken in hand by Hamburg. About 1810 the Spanish and Portuguese colonies in South America began to feel restless and to rise against their respective mother countries. Somewhat later Great Britain, following the general trend of development, threw her own colonies open to international trade. It goes without saying that Hamburg was one of the first ports to establish direct communication between Central Europe and those overseas countries. Numerous Hamburg firms set up branches abroad, especially in the new republics that had sprung up in South America, and the trading relations with North and Central America, with Africa, the Far East, and the Pacific countries and islands were largely extended. The foreign settlements of Hamburg firms were, indeed, the forerunners of German colonisation, and their foundation was followed up by new commercial treaties. Those years, indeed, witnessed the rise of Hamburg to the rank of a seaport whose trading associations reached to every part of the globe. The shipping business improved hand in hand with the growth of foreign trade. The gradual replacement of the sailing vessel by the steamship gave a new impulse to the whole development. The first steamer, an English one, arrived in Hamburg in 1816, but it was not until 1825 that the uninterrupted development of steamer traffic in the Port of Hamburg really set in, and the first Hamburg steamship-owning concern, the firm of Robert M. Sloman, was not founded until 1840. The Hamburg-Amerikanische Packetfahrt-Actiengesellschaft (Hamburg-Amerika-Linie), founded in 1847, started their servises by means of sailing vessels, but soon afterwards changed over to steamship operation. This is not the place to give a detailed account of the great development initiated in those days, and it must be sufficient to describe the enhanced demands made on the efficiency of the Port of Hamburg between the 'twenties and 'forties of the past century.

Those were the days of the Grasbrook schemes. The Grasbrook island was the area really mapped out for harbour improvements, even though the immediate object aimed at was the extension of the Niederhafen.

Reinhold Woltmann, since 1814 the head of the Harbour Construction Board *(Hafenbaubehörde)*, just created in connection with the general reorganisation of state administration, submitted his first Grasbrook scheme in 1828. It provided for the demolition of the fortification works still extant (a beginning of such demolition had been made as early as 1804), the intersection of the island by canals and roads, and the building of a large warehouse town also containing office blocks and dwelling houses. It also included the dyking proposals he had elaborated in connection with the Büsch scheme. The House of Burgesses rightly foresaw that the Grosser Grasbrook, the only area on the cityward bank of the Elbe that was still unbuilt upon, ought to be kept available for purposes of still greater importance to shipping, and refused to sanction the proposition.

Once more, viz., in 1825, an unusually high tide caused heavy damage to the city, and once more (1833), the Büsch-Woltmann dyking and locking scheme came up for very serious discussion. The House of Burgesses, however, again refused its consent, and the fate of the Grasbrook island continued to remain uncertain. Woltmann, therefore, devoted his immediate attention to the question of how to enlarge the Niederhafen. He proposed that the Johannisbollwerk and the blockhouse — both of which greatly obstructed traffic — should be demolished, that the palisades should be removed to a position nearer the shore, and that the harbour should be deepened. His 1835 project is of fundamental importance to the later developments in that it provided for the demolition of the bastions still guarding the Stadtgraben and for the widening of the latter, i. e., its conversion into a regular harbour basin. This was the first time that expression was given to the idea that was subsequently realised by the construction of the Sandthorhafen, and that contained in embryo shape the principle on which the entire future development of the Port of Hamburg was based. Woltmann also recommended that the projected basin should be provided with quay walls, warehouses, and cranes. He was, indeed, the first to demand, in clear and unmistakable language, that properly equipped quays should be built.

The House of Burgesses, before committing itself definitely, desired to profit from the experience gained by British port authorities in regard to harbour construction. Acting upon the suggestion of this body, the City Council immediately invited Charles Vignoles, a prominent British engineer, to proceed to Hamburg. His 1836 project incorporated many of Woltmann's ideas and contained proposals concerning the definite fate of the whole of the Grasbrook island. His plans for the complete demolition of the ramparts that were still left in the Niederhafen area, the construction of embankments as a protection against unusually high tides, and the widening of the harbour banks were certainly of great value, but his recommendations for the development of the Grasbrook were bound to provoke serious criticism. His suggestion was that the whole district should be used for the construction of a number of small curved harbour basins communicating with each other and with the Elbe by means of locks. It was the first time that the fateful question: "Dock harbour or open-basin harbour?" confronted the authorities. For more than twenty years this problem formed the subject of lively discussions. To Vignoles — familiar, as he was, with the port of London and other British ports — the decision in favour of the dock-harbour system seemed the natural solution. The hydrological conditions, however, of the British ports are altogether different from those prevailing in the Port of Hamburg, where the difference in the level of high tide and low tide is much less. This was clearly recognised by the Hamburg authorities, and the proposals were turned down without much debate. Woltmann, shortly before his death, had strongly recommended their rejection.

Fig. 56. Transhipment of Live Animals.

Woltmann's successor was Heinrich Hübbe. During his tenure of office the improvement of the harbour conditions, after an interval of almost fifty years, was taken in hand once more. The Johannisbollwerk was definitely demolished in 1843 and was replaced by the first massive shore wall. Lower down the river the first St. Pauli Landing Stages, a simple wooden structure, were built.

The Niederhafen was widened and its depth was increased to keep pace with the increased measurements of vessels. Woltmann's proposal concerning the old Stadtgraben was carried out, and the western portion of the present Sandthorhafen was constructed. The funds required for these improvements were borrowed, this being the first harbour loan raised by the city (1838).

Once more, however, the work that had been started was interrupted in order to give a foreign expert an opportunity to express his opinion on it. This was Mentz, a Dutch hydraulic architect, who approved of Hübbe's proposals, so that these were immediately carried out (1840). Mentz, however, exceeded the terms of his commission, and submitted a complete scheme for dealing with the Grasbrook island, based on the same principles as that previously prepared by Vignoles, but it was likewise rejected by the authorities. The latter, availing themselves of the presence in Hamburg of the Dutch specialist, asked him to submit a dyking scheme for the island of Steinwärder. This was the first time that the left bank of the Elbe — which at that time was still unbuilt upon — received the attention of the port authorities. The plans prepared by Mentz were carried out, and a number of industrial concerns settled on the island, most of them being associated with the shipping business.

Hübbe, whose authority had gained from the opinion expressed by the Dutch expert, continued to pursue his investigation of the Grasbrook problem. At heart he was an opponent — although not an uncompromising opponent — of the dock-harbour solution, but when the authorities once more consulted foreign experts on the subject, he failed to remain faithful to his conviction. The experts concerned were two Englishmen. One of them, William Lindley, had been resident in Hamburg for a number of years, and had distinguished himself in connection with town-planning matters. The other expert, James Walker, was specially called from England. These men, together with Hübbe, submitted their joint proposals — which acquired a certain amount of celebrity — in 1845. It is not difficult to trace in their scheme the rough outline of the later Sandthorhafen, Grasbrookhafen, and Magdeburger Hafen. Credit for this part of the proposals is due to Hübbe. The chief addition made by the two English experts consisted in the provision of locks by which the basins were to communicate with the Elbe. Although Hübbe, by his signature, sanctioned this latter proposal, he did so against his real conviction. A valuable feature of the project was the provision of railway connection for the quays. Such connection was possible because in 1844 the line to Berlin had been opened, and through it Hamburg had been linked up with the railroad system of her hinterland. The intention of the originators of the harbour scheme was that it should be proceeded with by instalments. The expenditure required for the first instalment was estimated at eight million marks, and the advantage derived from it would have been the addition of 444 berths for sea-going vessels and of 440 berths for rivercraft.

This scheme, however, also failed to secure adoption, and it must be admitted that, despite several valuable features it contained, its rejection was a

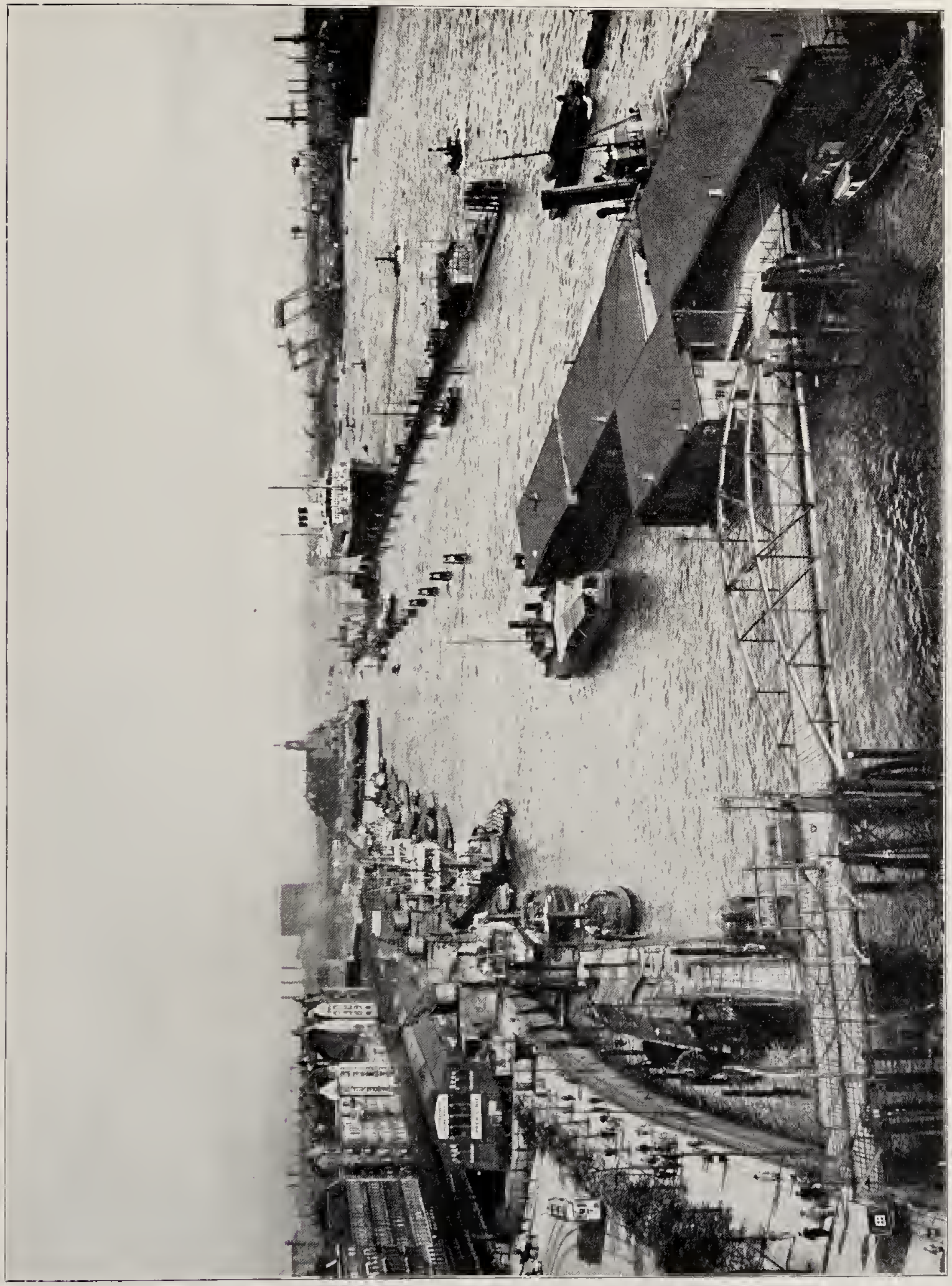
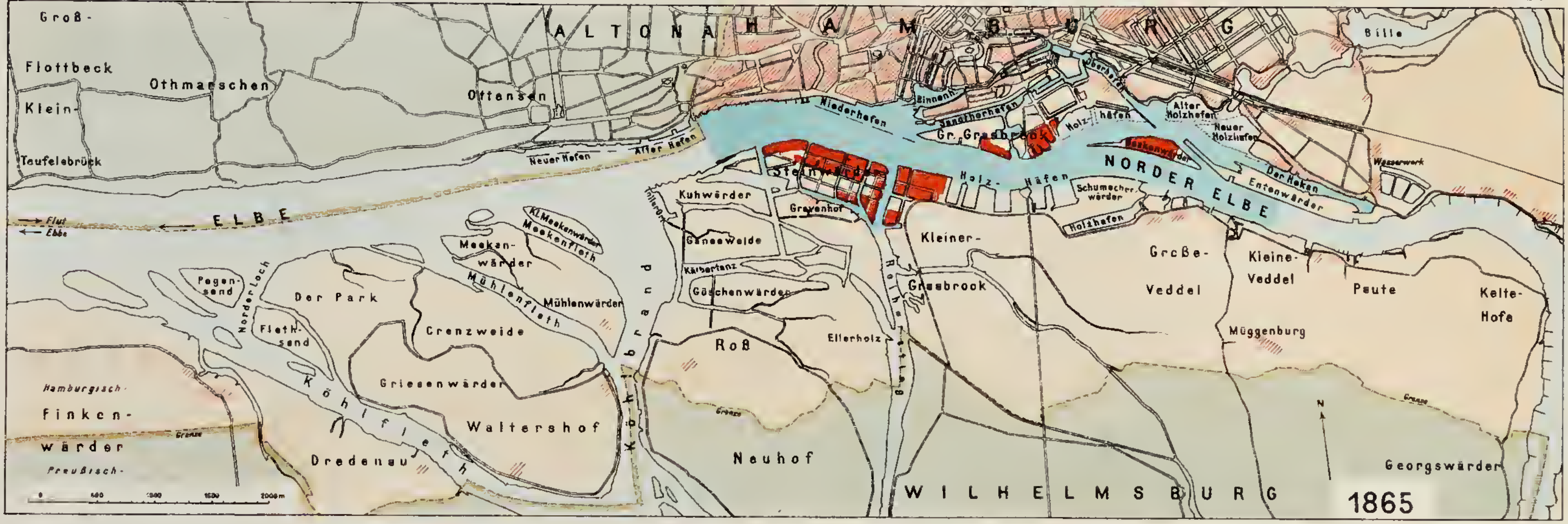


Fig. 57. View of the Main Elbe between St. Pauli and Grosser Grasbrook.

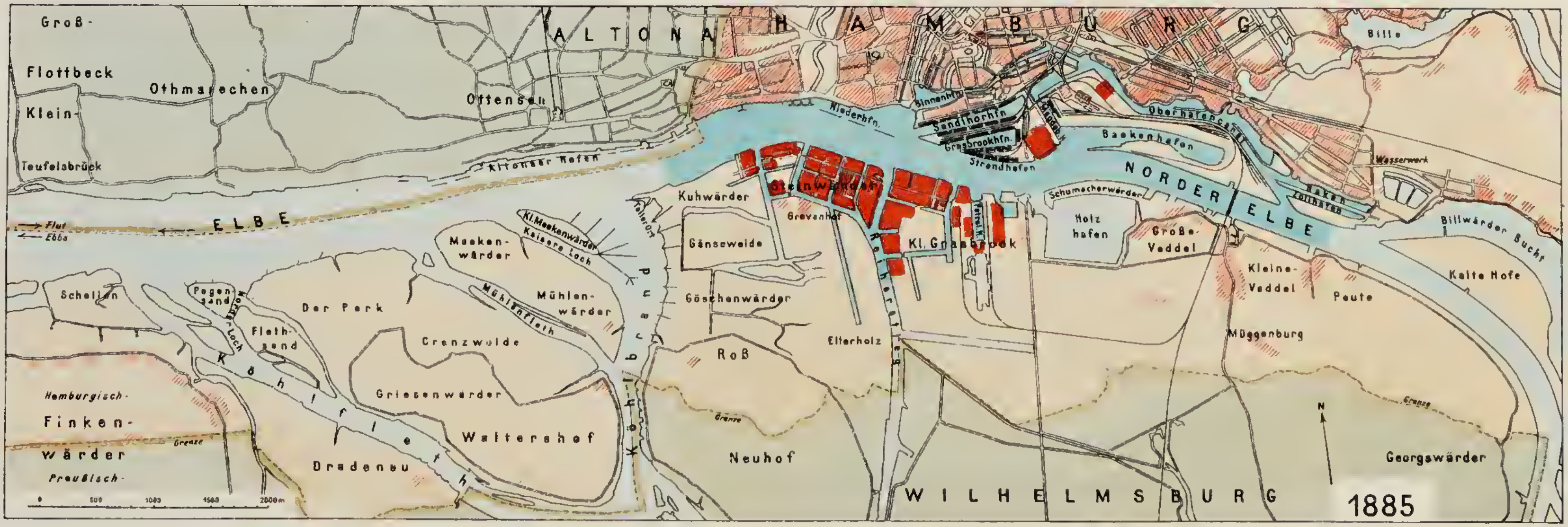
gain to the Port of Hamburg. Notwithstanding the high reputation Lindley enjoyed in Hamburg, his advocacy of the dock-harbour principle was highly unpopular. The result was a deadlock, and no further progress was made for some time in the development of the harbour. It is true that, in the early 'fifties, the last remnant of the mediæval ramparts, the Hölzern Wambs, was demolished, and that the disappearance of the palisades together with that of the boom and the blockhouse gave the Niederhafen a somewhat more modern aspect, but the policy pursued in the Grasbrook area was anything but farsighted. The harbour map of 1865 still shews the minute harbour basin then constructed, and the narrow watercourse connecting it with Sandthorhafen and the Elbe. It never was of any use to shipping, and was merged, at a much later date, with the Grasbrookhafen. That such inadequate provision was made at all, is due to the influence of Lindley who did not display much skill as a constructor of harbour works. If his proposal to sell the adjoining sites to private concerns had been acted upon, the damage resulting from it would have been still greater. Fortunately, however, Hübbe strongly and openly opposed this suggestion (1856) although Lindley had enlisted the sympathy of the City Council for it. In the end Hübbe's protest was crowned with success, but the whole affair, after prolonged proceedings before the courts, caused him to resign his appointment. His successor was Johannes Dalmann, his most gifted collaborator, who assumed office temporarily in 1856 and definitely in 1864.

Dalmann is the creator of the modern Port of Hamburg. He definitely settled the protracted controversy between the advocates of the dock harbour and those of the open-basin harbour by rejecting the former principle and adopting the latter. The very important memorandum issued by the *Commerzdeputation* in 1858 already contained a proposal for the suitable development of the Grasbrook basins which was largely the outcome of Dalmann's suggestions. The demand for open-basin harbours and for the provision of properly equipped quays was uncompromisingly set forth in it, but the question of management was still left open, no preference being expressed as to whether the quays should be exclusively operated by the state or whether their operation should be jointly conducted by the state and by private enterprise. It was, however, intended that the quays should not be exclusively operated by private concerns.

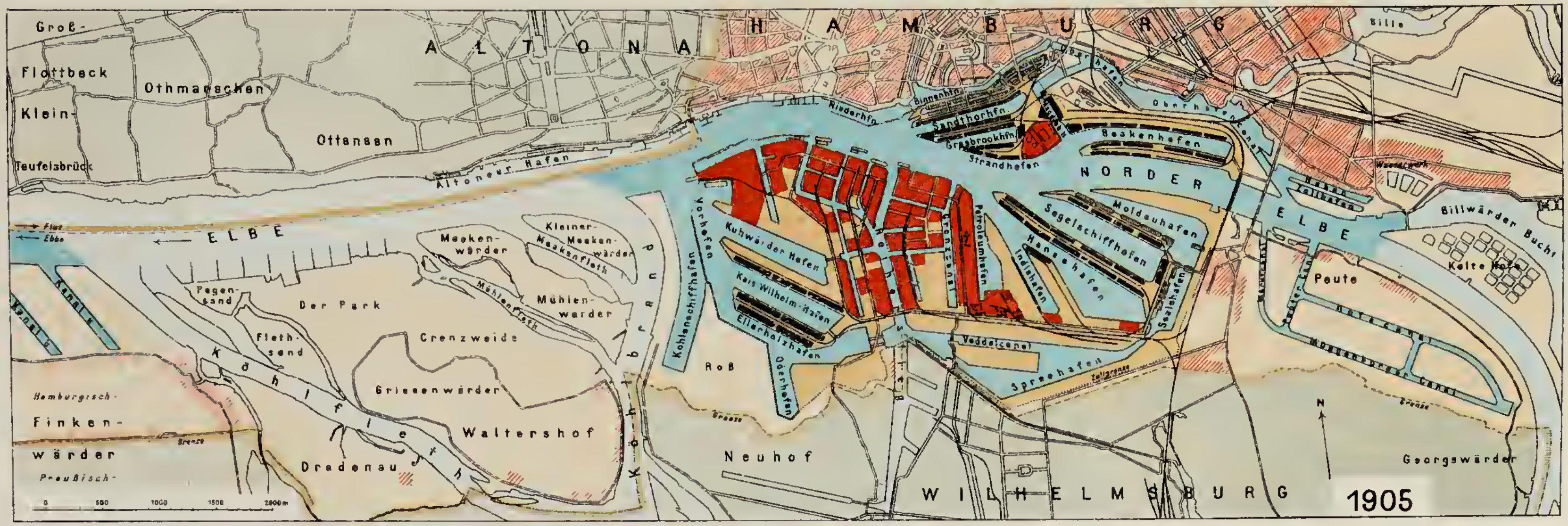
In the course of the same year, Dalmann, together with the Prussian expert Hagen, who shared his views, had an opportunity of submitting to the authorities a carefully thought-out project which was approved of by all the public and private bodies concerned. In 1862 he was in a position to start the construction of Sandthorquai, the first quay built in the Port of Hamburg. Before that time it had never been possible in Hamburg to discharge the ships' cargoes, with the aid of portable cranes, on harbour banks strengthened by protecting walls, to convey them to spacious quay sheds, and to re-forward them by rail, cart, or up-river barge to their final destinations. By making these

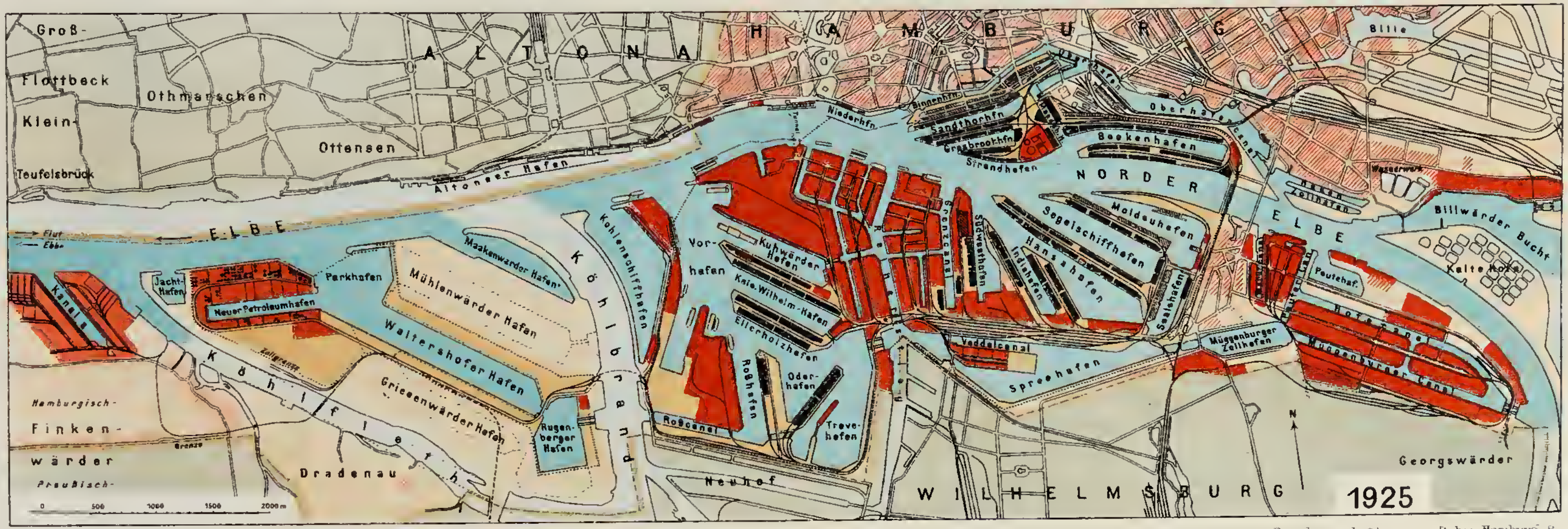

Groß-
Flottbeck
Klein-
Teufelsbrück
Othmarschen
Ottensen
ALTONA
HAMBURG
Bille
Niederhafen
Binnenh.
Sandthorhafen
Gr. Grasbrook
Holz-
häfen
Oberhafen
Alter Holzhafen
Neuer Holzhafen
Baakenwärder
Wasserwerk
Der Haken
Entenwärder
NORDER ELBE
Neuer Hafen
Alter Hafen
Steinwärder
Holz-
Häfen
Schumacher-
wärder
Holzhafen
Kuhwärder
Grevenhof
Tollerort
Flut
Ebbe
ELBE
Kl. Maakenwärder
Maakenfleth
Maaken-
wärder
Gänseweide
Kälbertanz
Göschenwärder
Kleiner-
Grasbrook
Große-
Veddel
Kleine-
Veddel
Peute
Kalte-
Hofe
Pagen-
sand
Norder Loch
Der Park
Mühlenfleth
Mühlenwärder
Crenzweide
Fleth-
sand
Köhlbrand
Reiherstieg
Roß
Ellerholz
Müggenburg
Griesenwärder
Köhlfleth
Hamburgisch-
Finken-
wärder
Preußisch-
Grenze
Waltershof
Dradenau
Neuhof
WILHELMSBURG
Georgswärder
N
0
500
1000
1500
2000m

1865


Groß-
Flottbeck
Klein-
Teufelsbrück
Othmarschen
Ottensen
ALTONA
HAMBURG
Bille
Niederhfn.
Binnenhfn.
Sandthorhfn.
Grasbrookhfn.
Strandhafen
Magdeb. H.
Baakenhafen
Oberhafencanal
Wasserwerk
Haken
Zollhafen
NORDER ELBE
Altonaer Hafen
Kuhwärder
Steinwärder
Grevenhof
Tollerort
Flut
Ebbe
ELBE
Kl. Maakenwärder
Kaisers Loch
Maaken-
wärder
Gänseweide
Petrol. H.
Kl. Grasbrook
Schumacherwärder
Holz
hafen
Große-
Veddel
Billwärder Bucht
Kalte Hofe
Kleine-
Veddel
Peute
Schellen
Pagen-
sand
Norder Loch
Der Park
Mühlenfleth
Mühlen-
wärder
Göschenwärder
Fleth-
sand
Crenzwolde
Köhlbrand
Reiherstieg
Roß
Ellerholz
Müggenburg
Griesenwärder
Köhlfleth
Hamburgisch-
Finken-
wärder
Preußisch-
Grenze
Waltershof
Dradenau
Neuhof
WILHELMSBURG
Georgswärder
N
0
500
1000
1500
2000m

1885





Bearbeitet im Kartographischen Bureau der Wasserbaudirektion Hamburg.

Druck von Jagdmann u. Bohm. Hamburg 8.

provisions, Hamburg freed herself from the tackles of mediæval tradition, and took the first step on the road that led to her development as a port of international importance. The first steamers to use the new quay arrived on August 15, 1866, and the state administration of the quays *(Kaiverwaltung)* which Hamburg, likewise in accordance with Dalmann's suggestion, had decided to adopt — was established simultaneously. The year 1866, therefore, was one decisively affecting the development of the Port of Hamburg.

★

II.

From the Foundation of the United German Empire to the World War.

Once the principle of the dock harbour had been ultimately rejected and a perfect model for the entire future development had been provided by the construction of Sandthorquai, the further advance was rapid and uninterrupted, except for the setback caused by the world war. A glance at the harbour maps of 1865 and 1925 (cf. Map No. VI) shews how greatly the rate of progress increased during the intervening sixty years compared with the preceding eight centuries. The two maps, indeed, may be said to represent a graphic illustration of the modern development of the world's trade.

Shortly after the completion of the first quay, communication between Hamburg and her hinterland was greatly improved by the city being linked up with the Cologne-Minden Railway (Cöln-Mindener Eisenbahn) whose terminus, since 1847, had been at Harburg. The Hanoverian government had always obstructed its further extension, and traffic between Hamburg and Harburg had been maintained, since 1851, by a makeshift arrangement consisting of a ferry for vehicular traffic from the Grasbrook to the opposite bank of the Elbe and by the main road to Harburg traversing the intervening island of Wilhelmsburg in a perfectly straight line. Between 1868 and 1872, after prolonged deliberations concerning the most suitable site, the first railway bridge was built across the Elbe, and in connection with it the Hannoversche Bahnhof. The entrance to the Oberhafen was shifted, by the construction of Oberhafencanal, from a place below to a place above the new bridge. The former island of Baakenwärder was joined to the mainland near the northern end of the bridge, so that the harbour basin called Baakenhafen was formed. It was originally used by rivercraft only, and its completion took place at a later date. Brookthorhafen, Deichhafen, and Billhafen were also constructed during the same period. A comparison of the 1865 and 1885 maps shews the changes just described.

Reference Note to the accompanying Map No. VI: Historical Development of the Port of Hamburg from 1865 to 1925. The Hamburg state territory has been indicated by a yellow, and the Prussian state territory by a green tint. Red indicates that the area concerned is covered with buildings. The area occupied by the Port of Hamburg is shewn by a darker tint.

In proportion as the rail-borne traffic expanded, the demands on quay space also increased. The harbour bank facing Sandthorquai was suitably developed from 1869 to 1872. It was called Kaiserquai and is the first quay provided with a solid quay wall.

The name "Kaiserquai" is reminiscent of an event that had just taken place, viz., the foundation of the united German Empire under William the First. After the dark days of the Napoleonic régime Hamburg gradually abandoned her policy of isolation and of neutrality which, until then, she had steadfastly pursued, and at the time the establishment of the North German Confederation she threw in her lot with the latter. It was not, however, until the foundation of the united German state that she obtained the powerful support that enabled her to compete with her rivals in the markets of the world. The development of her port, therefore, was very materially affected by the great political events of 1871.

Simultaneously with the construction of the Kaiserquai the second of the basins on the Grasbrook was completed. It was called Grasbrookhafen after the name of the island that had been the object of so much controversy. By giving the name of Dalmannquai to its northern bank an honour was conferred on the builder of the whole group of harbour basins. During the same year (1872) Schiffbauerhafen was opened to traffic.

At that time the southern shore of the Elbe also began to acquire more importance for the purposes of the port. Dolphins had been provided in those parts as early as 1855 to provide some much needed berthing space, but the first harbour basin on that side was not built until 1869. This was the nucleus of the old Petroleumhafen (now Südwesthafen), and its construction was prompted by the necessity of providing a suitable place for the transhipment and storage of dangerous combustibles sufficiently remote from the other portions of the harbour. The levelling-up and development of Steinwärder proceeded apace, and a number of industrial concerns began to settle on both sides of the mouth of the Reiherstieg. Further east a number of spacious basins of shallow depth were constructed for the accommodation of the rafts of timber to take the place of the timber basins on the northern bank of the river where room was urgently required for additional facilities of a different kind. In other respects the left bank remained unaltered for some time to come.

On the right bank the construction of Dalmannquai was followed up by that of Hübenerquai (Grasbrookhafen) and Strandquai (Strandhafen, facing the main river), but these quays were not then equipped with sheds. The St. Pauli Landing Stages were enlarged in 1868/72, the wooden structure being replaced by an iron construction. In 1875 the first public warehouse, the Kaiserspeicher, was opened to the public.

Thus far Johannes Dalmann was able to carry out the great work to which his life was devoted. On August 2, 1875 death deprived Hamburg of the services of this great man to whom her port owes so much. He was succeeded by

Christian Nehls during whose period of office some of the quay sheds on Hübenerquai (1877) and on Strandquai (1879) were taken over by the state administration of quays, and the wooden shore protections of Sandthorquai were replaced by a massive quay wall.

The early part of the 'eighties witnessed the beginning of a new chapter in the history of the city's economic development. When, in 1871, she joined the German Empire as one of its constituent states, she did not at the same time join the German Customs area. The two city-states of Hamburg and Bremen, faithful to their traditional policy, remained outside of it, because they had all along been staunch upholders of free-trade principles and had always firmly opposed protective tariffs. They had held themselves aloof from the movement towards a customs union which sprang up shortly after the days of the Congress of Vienna (1815) and which crystallised, in 1834, in the foundation of such a union. Their special position was recognised when the constitution of the North German Confederation was framed, and the article containing such recognition was also incorporated with the constitution of the German Empire (1871). It provided that "the Hanseatic cities of Hamburg and Bremen, together with such parts of their own and the adjoining territories as are required for the purpose retain their status of free ports and remain outside the customs area until they apply for admission to the German Customs Union". Accordingly, the whole of the Hamburg state territory, the districts of Altona, Wandsbek, and Wilhelmsburg, and the whole course of the Lower Elbe were excluded from the customs area, and 120 customs stations were provided along the Lower Elbe. Prince Bismarck — who could not but

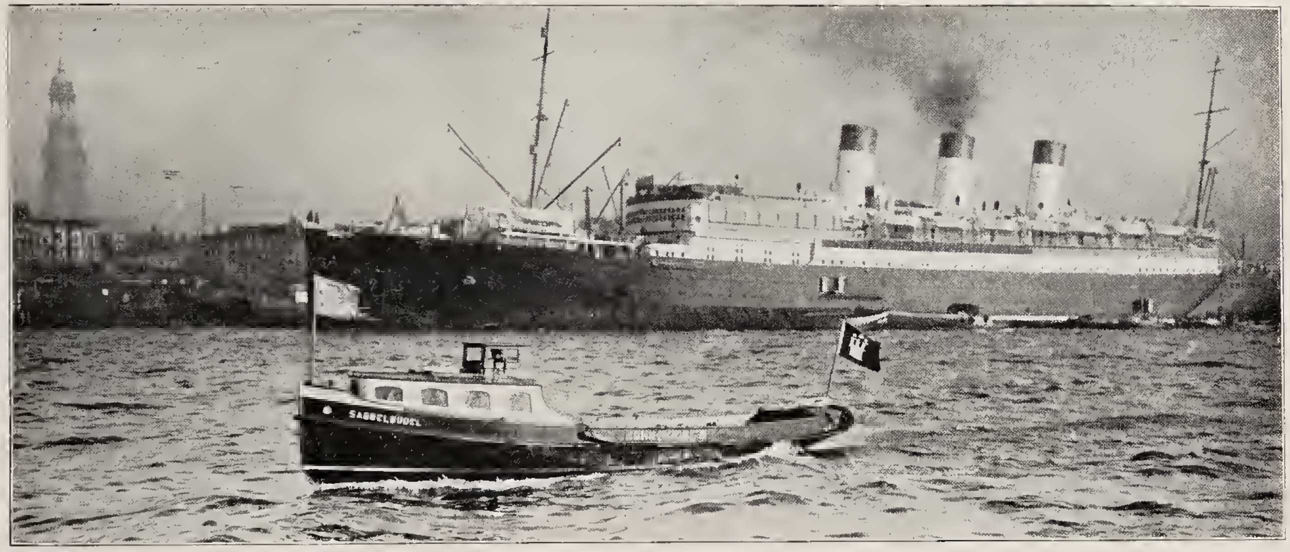


Fig. 58. The s. s. "Cap Polonio" berthed in Niederhafen.

regard the special position accorded to Hamburg and Bremen as a gap in his work — began, about the end of the 'seventies, to urge upon the two cities the desirability of joining the Customs Union. Public opinion in Hamburg was divided, those in favour of remaining outside being in the majority, although there were others who foresaw that the city, in the long run, was bound to profit from throwing in her lot with her German hinterland which had just started upon an era of great economic progress, and when Bismarck promised that not a mere bonded warehouse district, but a regular free-harbour area (where industrial concerns could settle without any restrictions) should continue to remain outside the customs area, his proposals were accepted. On June 3, 1881 the House of Burgesses passed the necessary legislation and on February 2, 1882 the agreement with the Empire was signed. Besides Hamburg, the Prussian districts above enumerated, including the Lower Elbe, were added to the customs territory. It was also stipulated that river traffic on the Lower Elbe should remain exempt from control by the customs authorities, provided that the vessels concerned were in charge of a pilot sworn in as a customs official. His presence on board was to be indicated by the black and white customs ensign during the day, and by a certain light after dark. The administration of the customs was entrusted to Hamburg. The national government contributed the sum of forty million marks to the expenditure incurred through the incorporation of Hamburg with the Customs Union. This is the only contribution it has ever made to the development of the Port of Hamburg.

A committee consisting of Messrs. F. A. Meyer, Zimmermann, and Nehls, was appointed to draw up a building plan for the whole harbour area so that the customs boundary could be fixed. As far as the districts east of the Köhlbrand are concerned, the line then fixed very nearly coincides with the present boundary, except that a fairly considerable enlargement of the free-port area was effected in the Ross-Neuhof district under the terms of the 1908 Köhlbrand Agreement. The free-port area on Waltershof was not added until 1922/1923.

The solemn incorporation of Hamburg with the German Customs area took place on October 15th 1888, and the free port was given over to its intended destination on the same day. Previously, however, a comprehensive building programme had been carried out in the harbour. The principal additions made between 1882 and 1888 are briefly enumerated below.

First of all the Grosser Grasbrook, and especially the Kehrwieder-Wandrahm island, were subjected to considerable alterations. A proper waterway connection — the so-called Zollcanal — was provided between the Niederhafen and the Oberhafen enabling vessels to proceed from one to the other without the necessity of touching any part of the free-port area. This was accomplished by widening the narrow watercourse of ancient origin separating the Kehrwieder-Wandrahm island from the southern edge of the city. The island itself was intended to accommodate the warehouses *(Freihafen-Lager-*

häuser) subsequently to be built. Owing to the density of its population, more than 1000 dwelling houses (including those near the fringe of the city and on the southern bank of the river) had to be pulled down, and new residential quarters had to be provided for almost 20,000 persons. A wide main road, properly levelled up so as to be out of the reach of the highest tides, was laid out skirting the edge of the city, and every bridge leading from it to the harbour area was rebuilt. The quay sheds still wanting on Hübenerquai and Strandquai were built, and the work on Magdeburger Hafen and Baakenhafen was completed. The Collecting Shed *(Sammelschuppen)* was built on the east side of the former, and Sheds Nos. 22 to 25 on Versmannquai (Baakenhafen). Owing to the necessity of continuing in a westerly direction the waterway of which the Zollcanal forms the main part, the Niederhafen could no longer be used as berthing accommodation for sailing ships. A new basin for these vessels (Segelschiffhafen) was therefore constructed (completed in 1888) on the left bank of the river. Its completion took place by instalments, and quay facilities were at first provided on Amerikaquai only (Sheds Nos. 38 to 40). Moldauhafen (1887) and Saalehafen (1888), two basins with barge-depth, were also constructed at that time. A second bridge was built across the Elbe in order to establish road communications with the new harbour areas. The whole of the free port was separated from the remaining parts of the harbour in the manner described elsewhere, and the various customs stations were provided in conformity with requirements.

Building activities in the Port of Hamburg by no means ceased when the city's incorporation with the Customs Union had been effected in 1888, because the predicted increase in trade and traffic took place even more rapidly than it had been expected. In 1889 the enlargement of the old Petroleumhafen (now Südwesthafen) was accomplished. In 1890 Sheds Nos. 34 to 37 on Asiaquai (Segelschiffhafen), and between 1891 and 1893 the additional quay facilities in Baakenhafen (except the fruit sheds) and on Kirchenpauerquai (except Shed No. 33), became available for operation. New basins were constructed in quick succession. In 1890 part of Spreehafen was completed, in 1893 Grenzcanal, and in 1895 Hansahafen and Indiahafen. The St. Pauli Landing Stages were again enlarged, and lower down the water's edge the fish market was laid out.

Christian Nehls, during whose term of office the enormous programme just outlined was carried out, died in 1897. He was succeeded by Max Buchheister.

Buchheister's directorship only lasted for six years. During that period work on the parts east of Reiherstieg was further extended. The fruit sheds on Versmannquai were completed in 1897 and 1899, and Sheds Nos. 41 and 42 on Amerikaquai and Nos. 43 and 44 on O'Swaldquai, as well as the Export Shed *(Ausfuhrschuppen)* on Magdeburger Hafen, in 1898. Shed No. 48 (Segelschiffhafen) was added in 1900. Above all, however, these years are notable for the completion (1897/1903) of the huge harbour basins and quays operated by the Hamburg-Amerika Linie, the leading Hamburg steamship-owning company. Elsewhere (page 170) it has been stated that Hamburg does not rigidly adhere to the principle of exclusively state-operated quays. The Hamburg-Amerika Linie was the first steamship-owning company to obtain a lease of state-owned quays, when the so-called Aktienspeicher near St. Pauli Landing Stages — a building of very moderate proportions — proved no longer adequate to its needs. During the period when the extensions to the port facilities necessitated by Hamburg's joining the German Customs Union were planned and built, the company applied for a lease of some of the new quays on Segelschiffhafen, and started, in 1888, the operation of Sheds Nos. 38, 39, and 40 on Amerikaquai. In 1893 it was found desirable to operate some quays situated nearer to the city, and the company obtained the lease of Petersenquai, Baakenhafen. In 1897 it took out the lease of Sheds Nos. 46 and 47 on O'Swaldquai, on the left bank of the Elbe. When, about the turn of the century, these leased properties also proved insufficient for the growing requirements of the company, and when it was found that the operation of quays located in different parts of the harbour area involved considerable inconvenience, the Government had no hesitation in having a selfcontained group of harbour basins, etc., built for it at Kuhwärder. Thus Kaiser-Wilhelm-Hafen, Ellerholzhafen, and Oderhafen — the latter at first only as a basin for

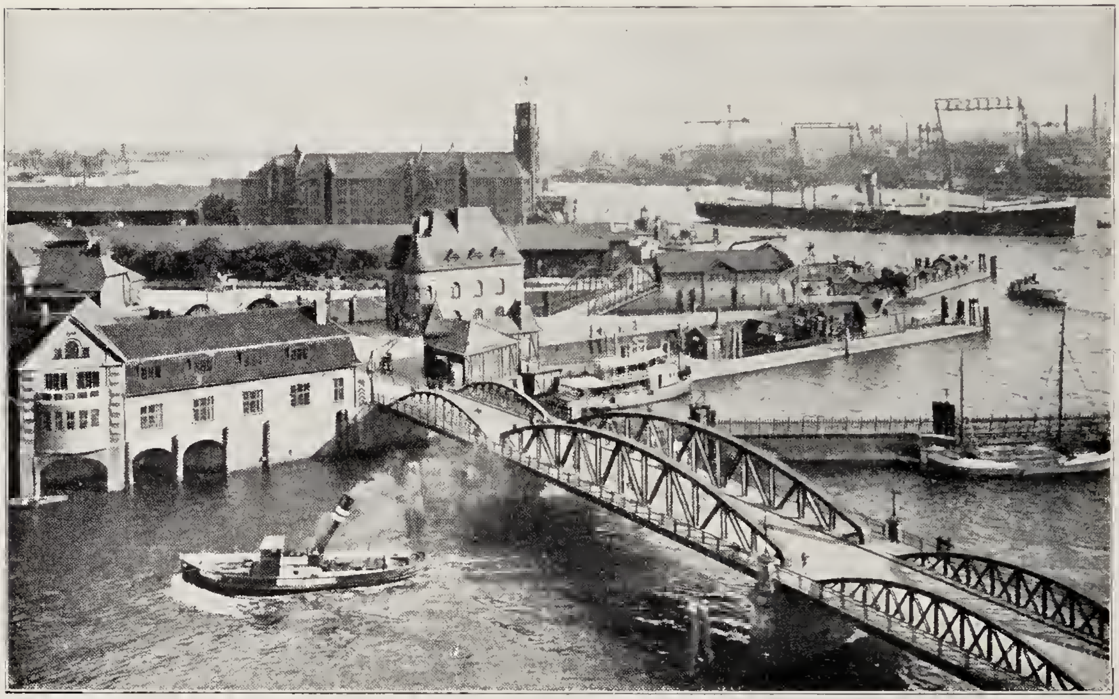


Fig. 59. Kehrwiederspitze (with Niederbaumbrücke, Custom House, Landing Stages, Quay Warehouse with Time Ball, and the Reiherstieg Schiffswerft in the background).

rivercraft and of the size and shape shewn on the 1905 harbour map (Map No. IV) — were constructed (1902/3). Kuhwärderhafen was built at the same time, its northern bank (Steinwärder Ufer), however, was assigned to the shipyard of Messrs. Blohm & Voss. Its southern bank (Grevenhof-Ufer) was not equipped with quay sheds by the Hamburg-Amerika Linie until 1907. In connection with the basins referred to and the Vorhafen leading up to them, the existing basin for harbour lighters *(Schutenhafen)* was enlarged (1908) and converted into a coal basin *(Kohlenschiffhafen)* with its west bank parallel to the mouth of the Köhlbrand as it was at that time. Simultaneously with the big harbour construction works on Kuhwärder Sheds Nos. 45 to 47 on O'Swaldquai (Hansahafen) were added (1903).

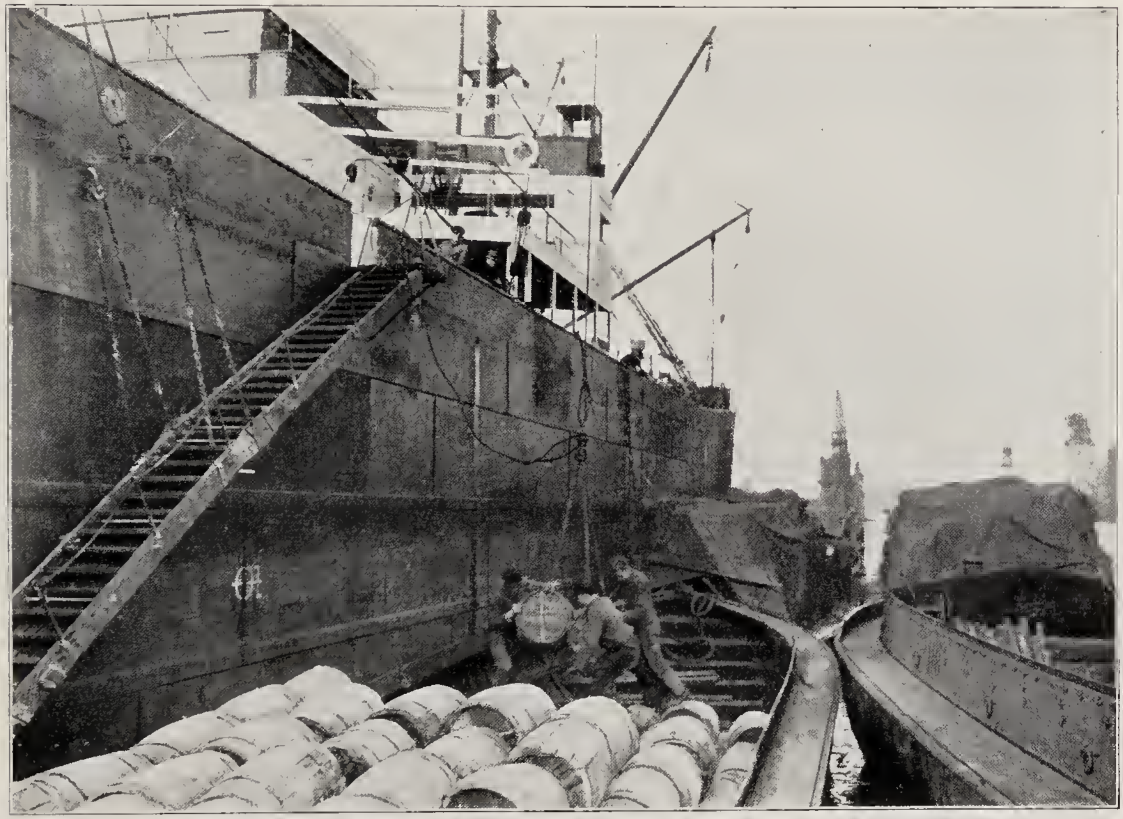


Fig. 60. Midstream Transhipment.

Buchheister just lived to see the close of this important period of building activity. He died in 1903. His successor as director of hydraulic engineering was Johann Friedrich Bubendey, who enjoyed a high reputation, both as regards the practical and the theoretical aspects of his subject. He found himself confronted with several important tasks concerning the further improvement of the port and the great work of regulating the course of the Lower Elbe to which reference is made elsewhere. Above all, however, his name is associated with the third Köhlbrand agreement (1908) the conclusion of which decisively affected both undertakings. The chief additions to existing facilities made during his term of office are briefly enumerated in the following account.

In 1905 the conclusion of the lease agreement with the Vulcan-Werke, of Stettin, necessitated the construction of additional harbour basins in the Ross district. As the Vulcan-Werke desired to transfer their chief yard to Hamburg, a suitable site had to be prepared between the old Kohlenschiffhafen and Oderhafen, and the required areas had to be made suitable for launching and equipping the vessels to be built there. Ellerholzhafen, therefore, was enlarged, and west of Oderhafen a new basin, named Rosshafen (completed in 1908), was constructed. The west bank of the latter, Vulcanquai, was placed at the disposal of the Vulcan-Werke. Oderhafen and Spreehafen, two of the basins used by rivercraft, were also enlarged, and by the construction of Müggenburger Zollhafen (1909) communication was established with the Peute canals built in the early years of the present century. At the same time Moldauhafen was enlarged, and the shed of the Vereinigte Elbe-Schiffahrts-Gesellschaften was built on Prager Ufer. The western portion of Grenzcanal was deepened for the accommodation of sea-going vessels. The *Rheindienst-Schuppen* of the Hamburg-Amerika Linie on Johannisbollwerk and the Distributing Shed *(Verteilungsschuppen)* near the eastern extremity of Kirchenpauerquai were also completed. The St. Pauli Landing Stages were rebuilt in their present form and were opened to traffic in 1909. The completion of the Elbe Tunnel in 1911 was the most important improvement affecting of communication between the two banks of the Elbe that had been made since the building of the road bridge across the river. The existing sheds for special purposes, i. e., the collecting shed *(Sammelschuppen)* and the exporting shed *(Ausfuhrschuppen)*, were added to by the building of the Distributing Shed already mentioned, of Shed No. 49 (Saalehafen, built 1907), of fruit shed "C" *(Fruchtschuppen* C, built 1911), of the fruit shed on Stadtdeich (1912), and of Shed No. 54 (Grenzcanal, 1913). Other buildings completed in the older part of the harbour area before the war include several quay sheds on the peninsula between Hansahafen and Indiahafen (Bremerquai and Australiaquai), Sheds Nos. 2 and 3 on Sandthorquai (replacing the older sheds of those names), and the rivercraft basin on Peute.

The further development of the harbour railroad stations and other railroad facilities kept pace with that of the basins and quays, but this is not the place to describe it in detail.

The main object of anxiety to Hamburg during the years of unparalleled progress immediately before the war was the problem of the future development of her port. The experience of the preceding forty years, during which the harbour area had increased in size several times over, furnished a certain clue to the development that might be looked forward to, and the demands of trade, shipping, and industry for additional harbour space still went on increasing. Above all, it was imperative to provide basins of greater depth, because without them the great improvement made in deepening the channel of the Lower Elbe necessitated by the increased draught of the giant liners would have been of slight practical avail.

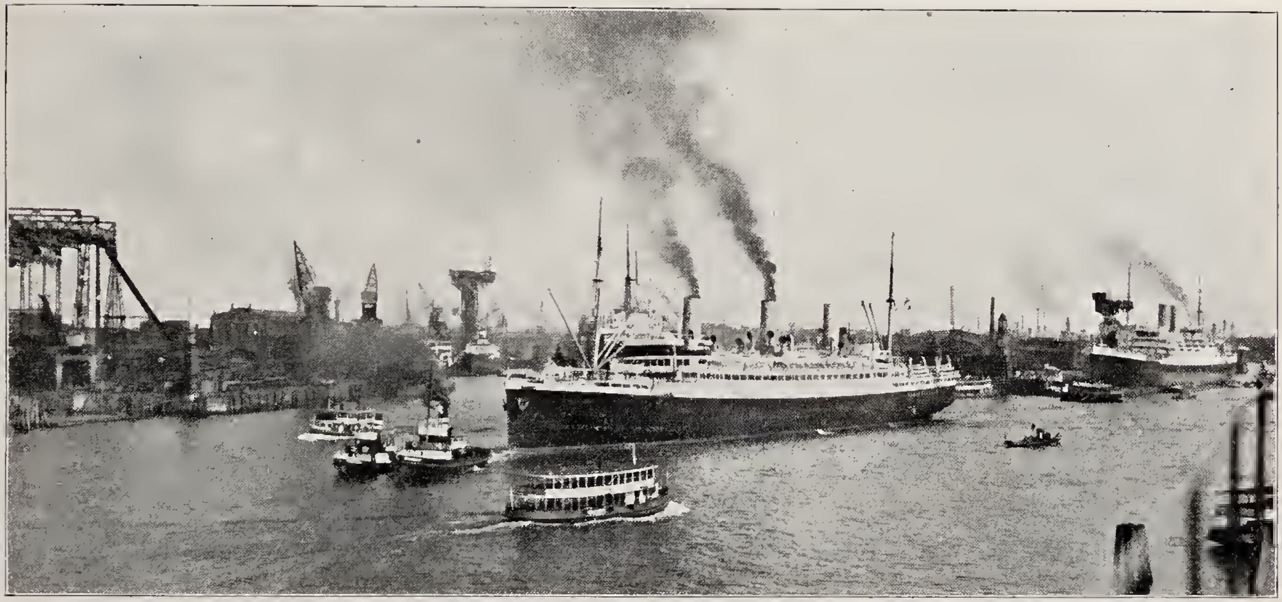


Fig. 61. View of the Hamburg-Amerika Linie's Harbour Basins on Kuhwärder (with s. s. "Resolute" and "Deutschland", and the Dockyard of Messrs. Blohm & Voss on the left.)

It was felt that the territory acquired by the city-state in 1768 was insufficient to meet all the needs of the future. For some time, however, efforts had to be concentrated on the utilisation of the territory still available. The Köhlbrand agreement of 1908, by which some small areas were exchanged between Hamburg and Prussia and by which the interstate boundary, especially in the neighbourhood of Ross and Neuhof, was slightly altered, provided a basis for further harbour projects affecting this district, the last part still available east of the Köhlbrand. Development, however, could not stop short there. The alteration of the Köhlbrand entrance that had been agreed upon between Hamburg and Prussia, together with the damming-up of Köhlfleth, Mühlenfleth, and Maakenfleth (cf. page 194) provided an opportunity for converting the small archipelago between the Elbe, Köhlbrand, and Köhlfleth into a single district capable of being utilised for harbour improvement schemes. The island thus formed was called Waltershof, after the name of the largest of the farms formerly existing there.

The great harbour improvement scheme dealing with these two areas was approved of in 1909, and the sum of 45 million marks was voted, without discussion, for taking in hand the first instalment of the work. The scheme comprised the following: The construction of a new coal basin (Kohlenschiffhafen) east of the new entrance to the Köhlbrand in the former entrance to this channel; the enlargement of Kuhwärder Vorhafen by the northern portion of the old coal basin; the improvement of the entrance to the Vorhafen (the southern portion of the old coal basin was transferred to the Vulcan-Werke for their purposes); the deepening of Oderhafen — which was only provided with barge depth — so as to make it suitable for the accommodation of ocean-going vessels; the replacement of Oderhafen as a rivercraft basin by the newly-built Travehafen and Rodewischhafen; the extension of the southern belt canal (cf. page 39) to the Köhlbrand by the construction of Ellerholzkanal and Rosskanal, and the extension of Rosshafen as far as its junction with Rosskanal. Communication between the two Köhlbrand banks was to be effected by a train ferry and suitable landing places. West of the Köhlbrand the following improvements were provided for: The construction of three big harbour basins parallel to one another suitable for ocean-going vessels of maximum draught, viz., Griesenwärder Hafen, Waltershofer Hafen and Mühlenwärder Hafen; the construction of Parkhafen, Neuer Petroleumhafen, Jachthafen, and Maakenwärder Hafen; the construction of Rugenberger Hafen for the accommodation of rivercraft, and that of a lock connecting it with the Köhlbrand. The building of a bridge across the Köhlbrand was not contemplated, and that of a tunnel was deferred to a later date. The linking-up of the new harbour area west of the Köhlbrand with the existing railroad system was to be accomplished by the construction of the Finkenwärder and Waltershof Railway (cf. page 51).

The major part of this comprehensive scheme — with the exception of the construction of Griesenwärder Hafen and Mühlenwärder Hafen, which was not intended to be taken in hand immediately — was completed before the outbreak of the war. The new facilities provided east of the Köhlbrand and the train ferry were ready in the summer of 1914. The excavation work on Waltershof was being actively proceeded with, Parkhafen, Neuer Petroleumhafen, Jachthafen, and Rugenberger Hafen had been practically completed, and some of these basins were already being used for their intended purposes, but the outbreak of the war delayed further progress, and after some time all work had to be stopped.

★

III.

From the World War to the present Time.

After the outbreak of the war the harbour operations, like every other part of the country's economic activities, had to be immediately adjusted to the altered conditions. The work going on in the quay sheds, shipbuilding yards, and other industrial concerns was, in some respects, even more brisk than in times of peace. Shipping, however, almost came to a complete stop about the close of 1914 when the last overseas steamer arrived in Hamburg, except that a lively interchange of goods with the Scandinavian countries *via* Kiel Canal could be maintained, the chief article exported to them from Germany being coal. The loading plants for coal and ore were used to their maximum capacity and were also made available for the purposes of the Imperial Navy. The pier cranes were utilised in like manner, because the sheds themselves, with insignificant exceptions, could not be used in the normal way. They were quickly emptied of the articles for export that had accumulated there when the war broke out, and were subsequently made use of for a number of purposes connected with the war. Some were used by the commissariat as store rooms for provisions, others by the various Government organisations created in connection with the conduct of the war, and so on.

Fig. 62. An incoming Steamer.

Some of these organisations continued to exist after the close of the war, and it was not until the early part of 1921 that all the quay sheds could be utilised once more for the purposes they were intended to serve. It was no easy matter, therefore, to satisfy the demands of shipping which commenced to undergo a rapid increase after 1920. Once a beginning had been made in re-knitting the ties that the war had severed, trade and traffic speedily resumed their pre-war proportions. Near the close of 1920 the gross register tonnage of the ships calling at the Port of Hamburg equalled 50%, early in 1923 100 %, and in 1925 120 % of the pre-war figure. It is true that in Hamburg, as elsewhere, the quantities of cargo loaded and discharged compared unfavourably with those handled before 1914, but they were nevertheless so considerable that the sheds were sometimes crowded with them and that their efficient handling was a matter of some difficulty, so that new extensions were once more required.

This development — which was not confined to Hamburg — was caused by the altered economic conditions after the war. The huge bulk cargoes that used to fill the ships' holds temporarily failed to be forthcoming, some of them, e. g., the imported cargoes of Chile saltpetre, being no longer shipped at all. General cargo and small lots of bulk goods dominated the traffic under the new conditions. Acceleration of despatch became more and more necessary where valuable cargoes, and cargoes subject to fluctuations in their value, were concerned. Many goods formerly carried by rivercraft now preferred the railroad, this being the faster of the two carriers. Certain economic rearrangements in the hinterland also caused a change in the routes of transportation which benefited the railroads to the detriment of rivercraft. The result was that transhipment on the quays, as compared with "midstream" transhipment, became subjected to a far heavier strain than before, and it was not till 1922 that the latter method began gradually to be in demand again. The tonnage handled by the quays in 1925 exceeded the corresponding figure for 1913 by 37 %, whereas the total increase — as has been stated — was only 20 %. In addition, the internal work carried on in the sheds was hampered by certain unavoidable delays in the manipulation of the goods, and by the increased demands of the latter on the quay space. The first-named inconvenience was due to the greater complications to which business became subject, to the greater differentiation of the lots, and to the additional time spent in weighing, whilst the second was caused by the increase in the quantities of cargoes for exportation that had to be handled on the quays. The collecting stations for export goods on the state quays increased from 104 before to 191 after the war, the latter figure corresponding to the larger number of shipping companies calling at Hamburg as compared with pre-war times. Exports, however, chiefly consisting of general cargo and having to be sorted according to their destinations in such a manner that they can be easily surveyed, make far higher claims on quay space than imported articles.

The altered conditions compelled the state quay administration and the private quay-operating concerns to do all they could in order to utilise their plant to maximum advantage. The means at their disposal were: a more rigid system of control, the utmost improvement of the organisation, and the use of modern machinery. It is due to the success that attended the endeavours carried out in all these directions that the Port of Hamburg may now claim to rank among the most progressive ports extant in regard to the facilities it possesses for the efficient handling of cargo.

However, the intensification of work just referred to was not sufficient in itself to satisfy the demands of the times. Although the financial difficulties confronting the city-state were enormous, the further expansion of the port could not be relegated to a future period. Moreover, the undertakings on which work had been suspended had to be completed. The number of shipping companies, both German and foreign, that made Hamburg a port of call for their big liners continued to increase, and the Board for Hydraulic Engineering *(Wasserbaudirektion)* found themselves confronted, at a time when the inflation crisis dislocated the whole economic life of the nation, with difficulties of unprecedent magnitude.

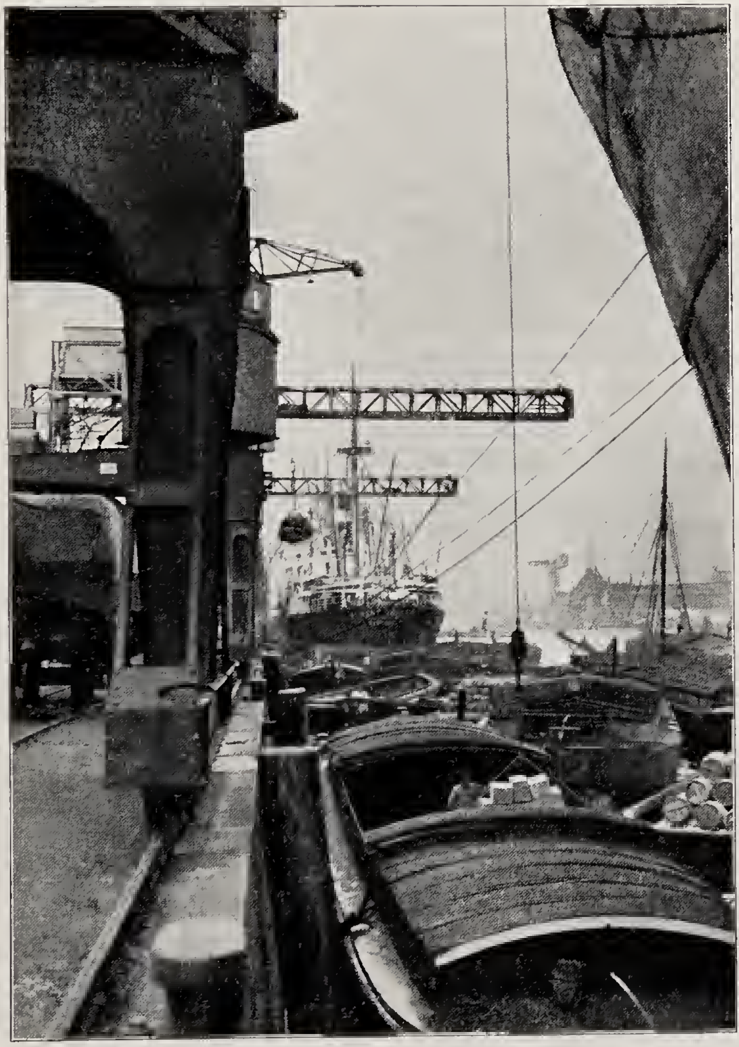


Fig. 63. Lighters berthed alongside a Quay.

Director Bubendey, during whose tenure of office the great work of regulating the Northern Elbe and the Lower Elbe was completed, died in 1919, about six months after the cessation of hostilities. The first-named of the two joint authors of the present volume, who had already been in charge of harbour construction work under Bubendey, was appointed his successor.

The principal tasks that hat to be taken in hand by the Port of Hamburg authorities during the period from 1914 to 1927 were the following: — (1) The further extension of the transhipment facilities in the older harbour sections,

i. e., those east of the Köhlbrand; (2) the work preparatory to the development of the harbour basins, etc., below the mouth of the Köhlbrand; (3) the extension of the railway facilities; (4) the provision of additional areas for industrial concerns intending to settle in the port; (5) the further consideration of the Hansa-Kanal project; (6) the transfer to the National Government of the waterways hitherto administered by the State of Hamburg, and (7) the conduct of negotiations concerning a change in the interstate boundary in view of a possible future extension of the harbour area.

As regards the further extension of the transhipment facilities in the older sections of the port, mention must be made of the construction, during 1915, of the "free loading plant" *(Freiladeanlage)* on Holthusenkai for the transhipment of bulk goods. It has subsequently been added to in various ways, and has only recently been enlarged by the provision of several new automatic grab cranes possessing a lifting capacity of five tons. During the same year work on the coaling quay *(Kohlenumschlagsquai)*, on Kirchenpauerquai with the wagon-tipping device for sea-going colliers and the corresponding plant for rivercraft, on Hofe-Canal, was actively proceeded with.

The conversion of Shed No. 23 into a fruit shed, already started before the war, was completed during 1915. Work on the new Shed No. 57 on Afrikaquai (Indiahafen), however, which was commenced about the same time as the conversion of Shed No. 23, went on until 1920. Subsequently, in 1924, the new shed was leased to a newly founded Hamburg shipping concern, viz., the Hugo Stinnes Linien. The first additional sheds actually completed after the close of the war were built by the Hamburg Government at the expense and for the use of two foreign shipping concerns, viz., the Royal Mail Steam Packet Company and the Americanische Verkehrsgesellschaft (American Line). The shed built for the former company is No. 80 on Stettiner Ufer (Oderhafen), and that for the latter concern is No. 84 on Rossquai (Rosshafen), both of them being completed in 1922. The corresponding quay walls and quay berths were leased to the two companies for the duration of the agreement. The state itself took in hand the building of the following sheds, viz., Shed No. 56 on Afrikaquai (Indiahafen), completed in 1923; Shed No. 81 on Stettiner Ufer, completed in 1925; Shed No. 33 on Kirchenpauerquai, completed in 1926, and Shed No. 85 on Rossquai, expected to be completed in the course of 1927. All the sheds added during the post-war period — with the sole exception of Shed No. 33, the floor space of which is only 56,000 square feet — belong to the largest type existing in the Port of Hamburg, their average floor space being 1000 × 160 feet or 160,000 square feet (For a description see page 83 *et seqq.)*. Moreover, four of them adjoin basins having a depth suitable for the biggest sea-going vessels (i. é., Oderhafen and Rosshafen), and this depth can be increased to 40 feet below high-water mark owing to the nature of the quay walls with which they are lined. A quay wall of analogous design was completed on Breslauer Ufer in 1924, so that accommodation suitable for two quay sheds of the largest type is available for immediate use.

In addition to these various new structures the state extended the existing transhipment facilities by the purchase of several others originally erected by private enterprise. Thus, for instance, some premises on the east bank of Grenzcanal used for warehousing purposes were acquired in 1924, and turned into what is now Shed No. 59. Its site adjoins a basin possessing barge depth, and it is used for the collection of goods intended for exportation and of cargoes discharged in midstream. An event of still greater importance was the acquisition, in 1927, of the three eminently modern Sheds Nos. 60, 61, and 62 on Kamerunkai (Südwesthafen), built by Messrs. Cohrs & Ammé, with state assistance, in 1924 and 1926. After the transfer of the facilities for the transhipment of dangerous combustibles, etc., to the new Petroleumhafen on Waltershof, the Südwesthafen was deepened and provided with equipment for general transhipment purposes.

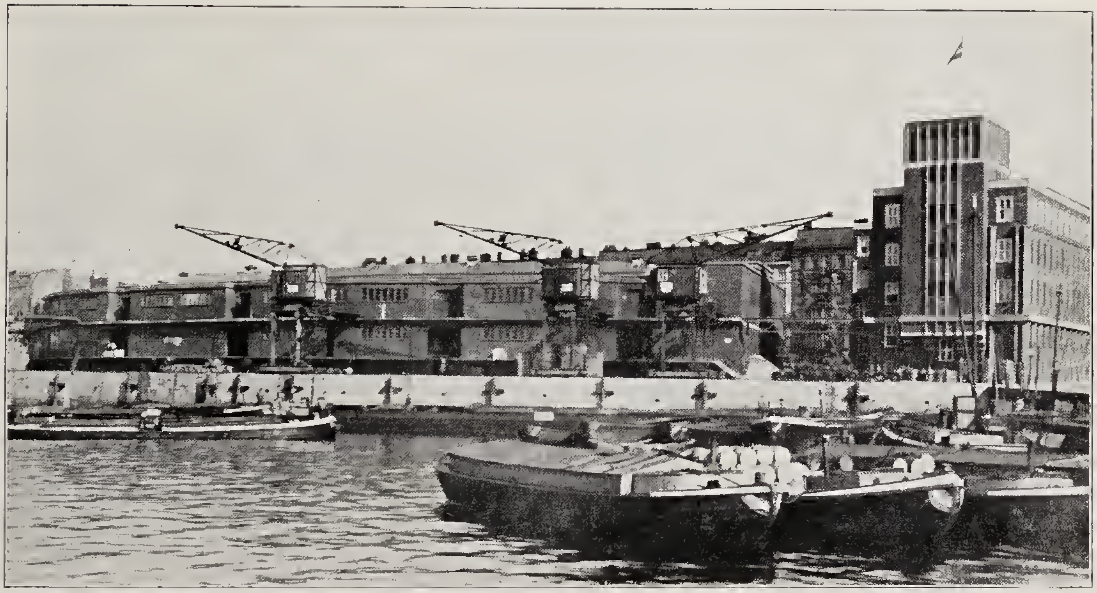


Fig. 64. Shed of the Schlesische Dampfer Co.-Berliner Lloyd A.-G. on Oberhafencanal.

The work carried out by the state for the enlargment of existing facilities and for adapting them to new conditions was supplemented by private enterprise. Shipments of refrigerated goods acquired additional importance after the war. In 1920 the Kühltransit-Gesellschaft had a cold-storage plant built in Shed No. 73. It is chiefly used for frozen meat and covers an area of 67,000 square feet. The same company started, in 1927, the operation of additional cold-storage rooms of 43,000 square feet of floor space. These are located on two floors of the warehouse built by the Lager- und Speditions-Gesellschaft adjacent to Quay Shed No. 69 on Grevenhof-Ufer, i. e., in the immediate neighbourhood of the plant just referred to. The goods are directly discharged from the ocean-going vessel into the warehouse. In 1926 were built the five-storied premises of the Eiswerke und Kühlhallen St. Pauli-Fischmarkt G. m. b. H. There up to 100 tons of ice can be made each day for the requirements of the fishing vessels and in connection with the transportation of fish, and 35,000 square feet of cooling and refrigerating space are available for the storage of fish. The firm of Behr & Mathew has now erected a cold-storage building for eggs (160000 square feet) in connection with Shed No. 85 (Fig. 53). The state itself is now considering the plan of converting part of Shed No. 16 (Grasbrookhafen) — where most of the herring steamers are discharged — into a cold-storage warehouse for herrings. Among the facilities recently provided by private enterprise, the warehousing and transhipment installation erected by Messrs. Jordan & Berger on Kamerunkai (1925) and the quay-operating and warehousing business conducted on Grevenhof-Ufer by the Lager- und Speditionsgesellschaft, deserve special mention. The premises where the business just referred to is centred consist of six new quay and warehousing sheds and Sheds Nos. 69 and 70 sub-leased from the Hamburg-Amerika Linie.

An important addition to existing facilities serving the needs of river transportation is the series of new buildings and constructions on Oberhafen-canal (cf. pages 41 *et seq.*), whilst further accommodation on water possessing barge depth has been provided on the island between Spreehafen and Veddelkanal, part of which is still available for future development. The island is connected with the railroad system by a bridge.

The second task that had to be taken in hand by the port authorities during the post-war period was, as has been said, to carry out work preliminary to the extension of existing harbour facilities west of the Köhlbrand. The first of the Waltershof group of basins, viz., the new Petroleumhafen, was ready for its intended use in 1913. Since that date its banks have been lined with facilities serving the needs of the oil industry and allied industries. The only other portion ot the Waltershof group actually used is Waltershofer Hafen. Originally serving the purposes of accommodating vessels that were to be broken up or laid up, it is now being increasingly employed for "midstream" transhipment, more especially for the discharge of grain by means of floating elevators, this being an operation not to any large extent requiring the provision of means of communication with the city or the railroad system. For the time being it is not intended to equip the banks of Waltershofer Hafen with any quay sheds, because this basin is exclusively reserved for "midstream" transhipment and for transhipment of bulk goods on so-called *Freiladekais*. The building of quay walls, on the other hand, has already been taken in hand. At present Burchardkai, the north bank, is being provided with a massive quay wall, 2000 feet long, extending 36 feet below low-water mark, and the necessary road and rail facilities are also being added. The reason why Waltershof has been reserved for the transhipment of bulk goods is that the *Freiladekais* now available on Afrikaquai, Holthusenkai, and Kirchenpauerquai are so favourably located in relation to the city that far better use can be made of them for the transhipment of general cargo. Two-thirds of the quayage on Afrikaquai have already been lined with sheds; on Kirchenpauerquai the transhipment of coal has been rendered increasingly difficult since Shed No. 33 has been built, and a similar difficulty will arise sooner or later on Holthusenkai. The projected Finkenwärder Railway will facilitate the transhipment of bulk goods on Waltershof, but this line will also be needed to take care of the brisk traffic moving to and from the new Petroleumhafen and to and from the Deutsche Werft shipyard, which was built on Finkenwärder during the war. At present the Waltershof branch is the only part of the line on which work is proceeding. It is now nearing completion. Provisional rail connection with Finkenwärder has been provided by a track connecting the Waltershof end of the Köhlbrand train ferry with this island and by a temporary bridge across the Köhlfleth. The two existing harbour railroad stations of Hamburg-Süd and Kai-rechts are to be supplemented by a third station on Waltershof near the watercourse just mentioned.

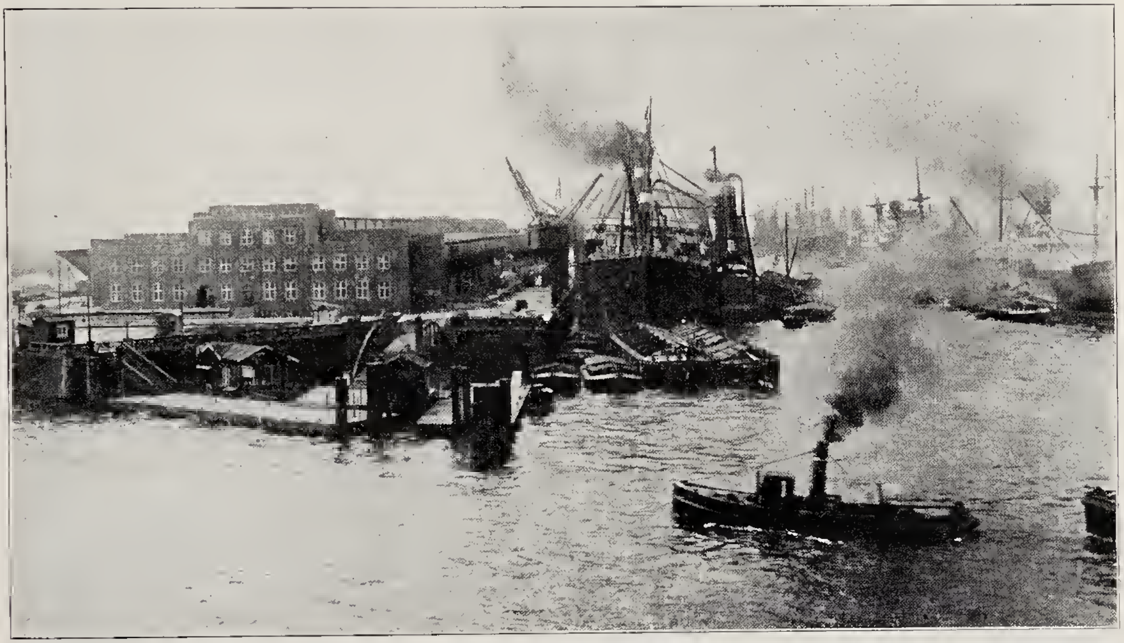


Fig. 65. Quay Shed No. 80 on Stettiner Ufer, Oderhafen.

The provision of these railroad facilities has now made it possible to take in hand the work required to carry out the extension scheme for the harbour basins, etc., on Waltershof. The scheme includes, among others, the building of two big basins for sea-going ships, flanking Waltershofer Hafen on either side. One of them, Griesenwärder Hafen, is in course of construction. This basin, when completed, will be the first post-war addition to existing basins.

It will occupy an area of 90 acres, viz., 80 acres for the use of sea-going vessels and 10 acres possessing barge depth only. It will have a depth of 36, and later of 40 feet below high-water mark and will thus be capable of accommodating the largest type of vessels. Its south bank will be lined by about 4,000 feet of quay walls, so that opportunities will be available there for the transhipment of bulk goods from sea-going vessels to the railroad and *vice versa.* Sea-going vessels will be able to enter it *via* Parkhafen, and rivercraft *via* Rugenberger Hafen. The passage connecting it with the latter basin will be bridged. A novel feature will be the provision of a specially enlarged basin for the accommodation of harbour lighters, having a depth of only 20 feet below high-water mark, at the upper end of the basin for sea-going vessels. The north bank of Griesenwärder Hafen will be left sloping until the need of additional quay space makes itself felt. After the model of Waltershofer Hafen a row of dolphins, serving the needs of "midstream" transhipment, will be erected in front of the sloping bank, but will be removed again after the provision of a quay wall, so that in future the whole width of the basin — which amounts to 700 feet — will be exclusively reserved for transhipment with the aid of quay facilities. The area of Griesenwärder Hafen, together with that occupied by the railroad station near Köhlfleth referred to above, will be incorporated with the Waltershof free-port zone. The peninsula that will be formed between Waltershofer Hafen and Griesenwärder Hafen will ultimately possess a width of 660 feet and will provide additional sites for quay facilities. Maakenwärder Hafen has for the most part been reserved for the needs of coastwise shipping and Lower Elbe traffic, but near its south bank quay installations for the use of sea-going vessels can be added. The preceding account shews that during the immediate future there is still plenty of space on Waltershof that can be utilised for harbour extension purposes before it will become necessary to proceed with the building of the likewise projected Mühlenwärder Hafen and its banks. Nevertheless, some of the excavation work in connection with this basin has already been started upon as part of the emergency programme for the relief of unemployment.

The third post-war task facing the harbour authorities was the extension of the railroad facilities in the Port of Hamburg. On page 46 *et seq.* it has been shewn that the Port of Hamburg Railway forms an integral part of the railroad organisation serving the Greater Hamburg area, and brief mention has been made of its proposed extensions. The greater portion of this extension work, as far as it has been completed up to now, belongs to the post-war era. Eidelstadt station has abready been opened, and Billwärder and Meckelfeld stations are nearly ready for the traffic moving in one direction. The Circular Goods Railway *(Güterumgehungsbahn)* is for the most part still building. In conjunction with this extension work of a general character the Port of Hamburg Railway has been further developed to cope with the increased demands and in accordance with the available space. The important addition to it in the shape of the Hausbruch-Waltershof branch line has already been referred to.

Hamburg-Süd station was enlarged as far as existing conditions permitted. A further shunting group and a modern all-electric power plant were added to it. Most of the work on Ross station was carried out after the close of the war along with the construction of the neighbouring harbour basins, etc. Peute Station had to be re-built on a site further south owing to the need of the adjoining industrial concerns for expansion. Outside the stations several sorting groups, chiefly used by empty privately-owned trucks for special purposes, e. g., frozen-meat trucks, banana trucks, and tank waggons, were constructed. By providing these various additional facilities — which led to an increase in the total track length required by the Port of Hamburg Railway amounting to 227 miles — it has become possible to successfully cope with the growing needs of harbour traffic, which are at times very considerable indeed.

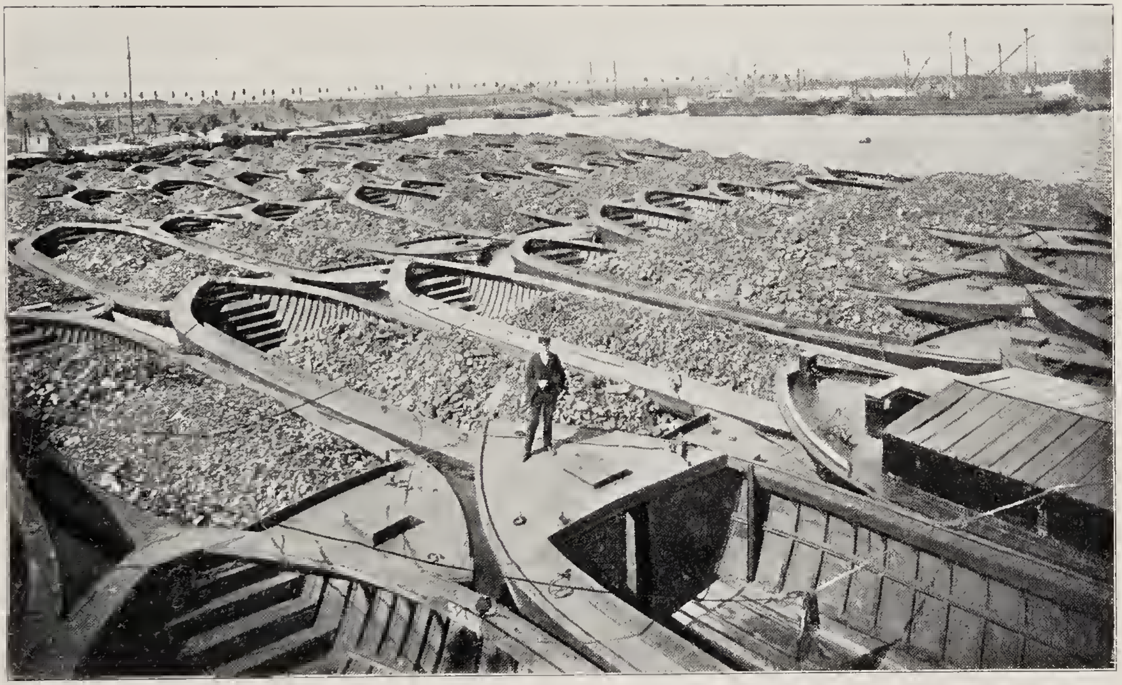


Fig. 66. Floating Coal Stores in Travehafen.

In this connection brief reference must be made once more to the third bridge across the Elbe *(Freihafen-Elbbrücke)*. Work on it was started previous to the war, but it has only just been completed. When it was opened to traffic in the spring of 1926, a valuable improvement was added to the existing organisation for handling the railway traffic of the port.

The provision of additional areas suitable for industrial purposes has been the fourth task before the port authorities in the years following the close of the war. The biggest concern that settled in Hamburg during the war was the Deutsche Werft. The first section of the Finkenwärder foreshore available after its levelling-up was allotted to this undertaking. The second *(b)* of the four cuts referred to as *a*, *b*, *c*, and *d* respectively that were left open when the Finkenwärder foreshore was levelled up was subsequently filled up with sand, etc., whereas cut *a* was provided with a quay wall and an equipment quay. The remaining structures erected by the concern include, apart from the engine shops and other plant, a number of small slips and four large slips for the building of big ocean-going vessels.

Other industries, too, demanded additional sites in the harbour, both in the free-port zone and in the Customs Union section, this demand being largely prompted by the difficult economic conditions during the post-war period which caused numerous firms of manufacturers to prefer a seaport domicile to one in the interior of the country. The whole of the Peute district was utilised for industrial purposes, and the necessary extensions and additions to existing facilities were made. Above all, however, additional areas were levelled up in the extensive Billwärder and Moorfleth district, and the building of the three canals was completed. There a large number of suitable sites is still available, all of them being provided with road and rail connections and possessing convenient waterway communication with the harbour, of which they are within easy reach.

In addition to carrying out the important tasks outlined in the preceding account, all of which were directly associated with her port, Hamburg, during the period under review, had to devote her attention to a number of other matters also closely affecting the further development of the former.

One of these matters is the problem of the projected Hansakanal the construction of which has been advocated by Hamburg together with the other interested parties (cf. page 11 *et seq.)*.

Other matters of this kind relate to the steps to be taken in compliance with certain provisions of the new German constitution dealing with the centralisation of customs and traffic affairs. When the railways previously operated by the federal states were transferred to the national government, the Port of Hamburg Railway continued to be owned and operated by Hamburg. Customs matters, on the other hand, which had been administered by Hamburg since she joined the Customs Union and built her free-port, were taken over by the central authority in 1919. More important to Hamburg than either of these two changes was the transfer of the waterways from the states to the national government, which took place on April 1, 1921. This measure deprived Hamburg of a privilege which she had exercised for almost seven and a half centuries and which had been of eminent benefit to her in developing into a port of international status. However, after prolonged discussions preceding the transfer she was promised that the task of regulating the Lower Elbe and of maintaining the proper depth of the channel leading from the sea to her harbour should continue to be performed in the same efficient way in which she had carried it out herself. The reach of the Elbe from Ortkathen to

Blankenese, being regarded as an integral part of the Port of Hamburg, was immediately re-transferred to the Hamburg administration.

Before concluding this review of the most recent period in the history of the Port of Hamburg — a period replete with changes of fundamental importance — we must briefly comment on the possibilities of its future development.

As far as the older area, i. e., the districts east of the Köhlbrand, is concerned, these possibilities are very limited indeed. The only embankment facing water of a depth suitable for sea-going vessels and still devoid of any proper facilities is Togoquai (Südwesthafen). After providing it with a quay wall, it will be possible to use it for the erection of fairly considerable shed accommodation. Two further sheds can be built on Breslauer Ufer (Oderhafen) where the quay wall is already in existence. Aftert he transfer of the *Freiladeanlage* occupying the southern portion of Afrikaquai (Indiahafen), a site will be available for the projected Shed No. 55, and four additional sheds can be built on Holthusenkai and Kirchenpauerquai after the present *Freiladeanlagen* have also been transferred to Waltershof. This enumeration exhausts the possibilities existing in the older harbour section.

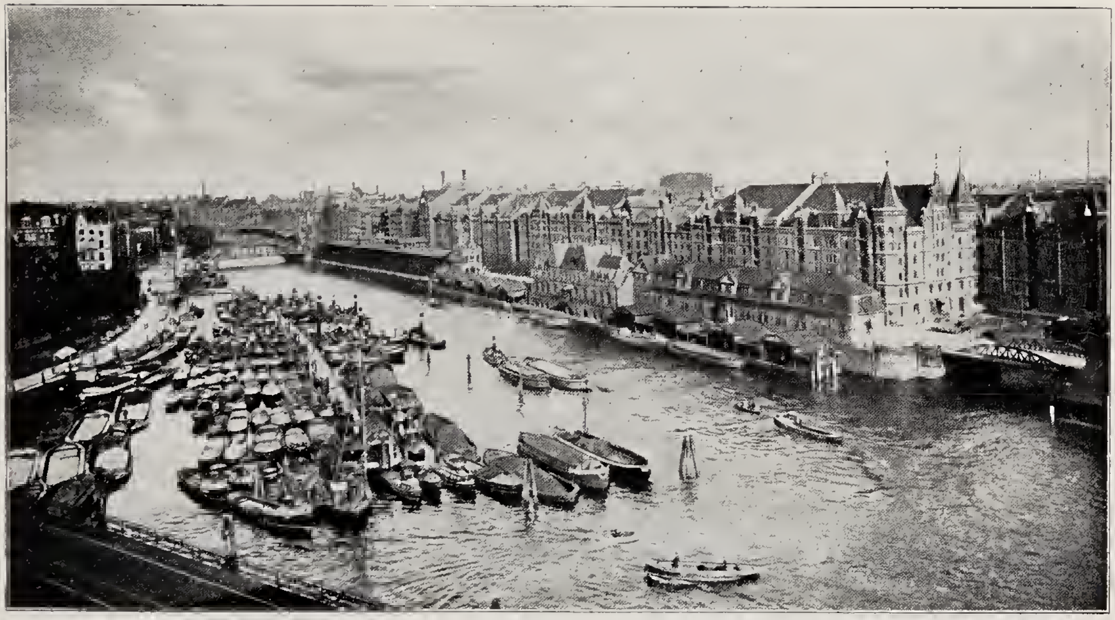


Fig. 67. Binnenhafen and Zollcanal (Lighters, Custom Houses, and Warehouse).

The areas still available in the Waltershof district have already been enumerated elsewhere.

When these, too, have been utilised in full, the only suitable areas available on Hamburg territory will be the districts of Dradenau and Finkenwärder. The reserves of space owned by Hamburg for the extension of her port are sufficiently large to satisfy every requirement of the immediate future; but the city, mindful of her past history, must look much further ahead than that. At present it is doubtless even more necessary to pursue a longsighted territorial policy than it was at the time of the Treaty of Gottorp (1768). To-day it is not a mere problem of space, but rather one involving the future economic organisation of the whole area. Questions affecting the interests of shipping are largely intermixed with others concerning local traffic and housing accommodation. If Hamburg is to do justice to these various demands, she must be able to exercise far more liberty of action in regard to the area controlled by her for these purposes. Her position as a seaport of national and international importance compels her to take up this attitude. It is impossible to estimate at the present moment what prospects there are of ever forming a large administrative unit comprising the whole harbour area between the Northern and Southern Elbe, because the negotiations between Hamburg and Prussia —which have been going on since 1917 —have not led to any result up to now. It may, however, be taken for granted that Hamburg need not be under any apprehension about the development of her port either now or during the more distant future, and that such development will be guided by the desire to promote the economic interests not only of Germany, but of the world at large.

SECTION FIVE.

The Organisation of the Harbour Services.

State Operation and Private Operation.

The various harbour services are partly operated by the state, and partly by private enterprise. This twofold division is the outcome of historical development, and its existence is clearly evident in the organisation of the principal function exercised by the Port of Hamburg, i. e., the transhipment of goods. Midstream transhipment, the older of the two methods now in use, has always been — and still is — the special domain of private activity, whereas quay operation — which was non-existent in Hamburg as recently as sixty years ago — is looked upon as a function which largely concerns the public interest, and the state has always maintained its right to exercise it through its own organisations, at least in principle. And even where this principle, for good reasons, has been disregarded, the state has reserved to itself a certain right to supervise the use made of the facilities provided. Three main considerations have always guided the state in the exercise of its

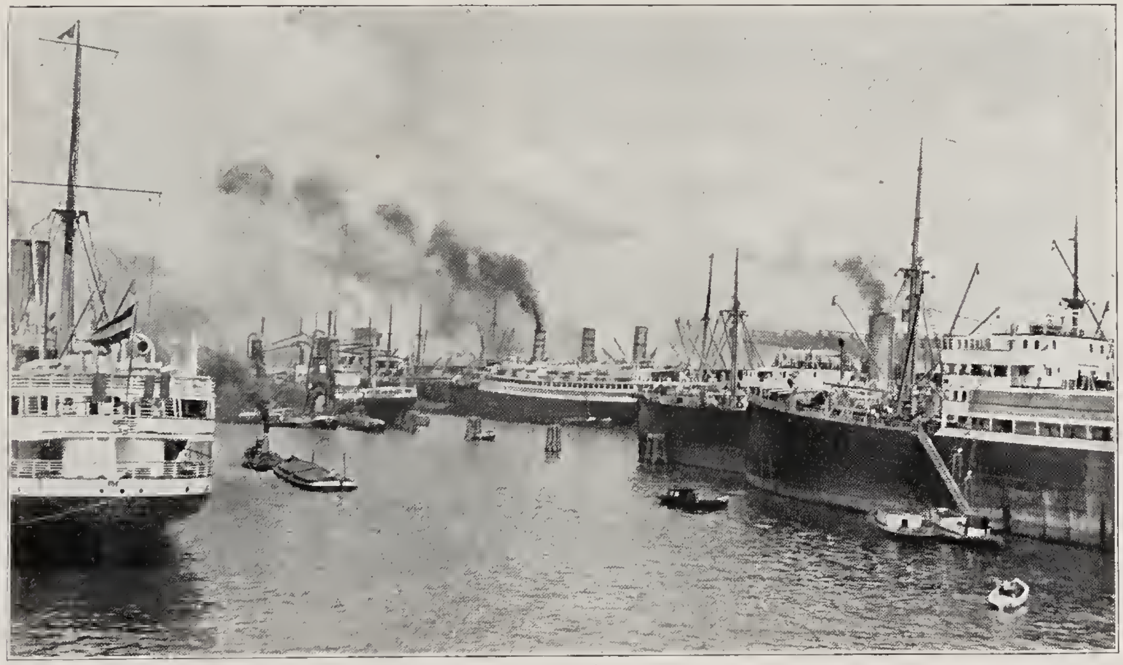


Fig. 68. Some Hapag Steamers berthed in Kaiser-Wilhelm-Hafen.

authority in matters relating to the harbour, viz., (1) that berthing accommodation should be allotted impartially to all comers; (2) that the harbour facilities should be employed in conformity with their intended purposes, and (3) that they should be appropriately utilised in accordance with their respective capacities. Only a body not exclusively influenced in its decisions by business considerations could be expected to apply these guiding lines to actual practice. As regards midstream transhipment, all that is necessary in order to comply with the above principles is the assignment of berthing space by the organs appointed by the state. In the case, however, of transhipment by means of the quay facilities, the allotment of berthing accommodation is so closely connected with the use of the whole equipment and machinery that both functions must necessarily be exercised by the same body. The state, on the other hand, has had no hesitation in admitting private enterprise to step in where the three considerations enumerated above do not apply.

A sharp line of demarcation cannot, therefore, be drawn between state-operated and privately-operated services in the harbour. The warehousing business, for instance, is partly operated by mixed concerns in which both the state and private enterprise participate, and partly by private firms. Quay operation is another function which the state, in certain instances, has allowed to be conducted privately. Certain state-owned quays have been leased to some leading shipping companies, to whom, under the terms of the lease, the right has been granted to operate them themselves. Such leases, however, are strictly limited to companies carrying on business by means of their own ships. The advantage to them is that they can load and discharge their vessels *ad libitum*, whereas vessels using state-operated quays are allotted their berths according to some principle ensuring impartial treatment for all.

All other harbour services, i. e., all those performed in the harbour besides quay operation and the warehousing business, are purely private undertakings. Their number includes, among others, many of the warehousing concerns, the stevedoring, lighterage, and towing companies, the harbour shipping service, and the cartage business.

★

The Public Authorities connected with the Port of Hamburg.

We now turn our attention to the public bodies connected with the harbour and to their administrative organisations. The highest authority appointed by the Hamburg State for the purpose of dealing with the numerous matters concerning the port is the Committee for Trade, Shipping and Industries *(Deputation für Handel, Schiffahrt und Gewerbe)*. This body has a senator for its chairman and is composed of members representing the Senate, the House of Burgesses, the Finance Committee *(Finanzdeputation)*, the Chamber of Commerce, the Chamber of Industries, the Chamber of Retailers, the Chamber of Consumers, and the Workmen's Council *(Arbeiterrat)*. The Quay Administration *(Kaiverwaltung)* and the Port Captain's Office *(Oberhafenamt)* are subordinated to its authority. Other public bodies subordinated to the Committee in respect of matters affecting the harbour are: the Board for Trade Statistics *(Handelsstatistisches Amt)*, which, in addition to the exercising functions indicated by its name, also compiles the traffic statistics; the Free Port Office *(Freihafenamt)*, which deals with customs matters as far as they concern the management of the harbour; the Ship's Measurement Authority *(Schiffsvermessungsbehörde)*; the Ship's Registry Office *(Schiffsregisterbehörde)*; the Nautical College *(Seefahrtschule)*; the Shipping Office *(Seemannsamt)*, and the Board of Fisheries *(Fischereidirektion)*.

Fig. 69. A rough day on the Elbe near Kaiserspeicher.

The Quay Administration is by far the largest of the bodies just enumerated. Its principal task is to manage the state-operated quays. Its authority, subject to that of the Committee to which it is subordinated, extends to the following matters: the drawing-up of its own estimates and the administration of its own budget (and therefore also the fixing and collection of the quay charges, because it is held generally responsible for the remunerative operation of its services); the upkeep and modernisation of the quay equipment and the provision of any necessary additions; the preparation of plans for additional harbour facilities; the protection of the public interest when agreements concerning quay leases are drawn up; the collection of the quay rentals; the management of the Port of Hamburg Railway *(Hafenbahn)*, and all questions concerning its staff and the social welfare arrangements for the benefit of the latter. Its staff consists of about 800 clerical and other employees, whilst the number of workmen employed by it fluctuates between 4,000 and 6,000, according to requirements. The main office of this authority is situated near Brookthor, east of Sandthorhafen.

The roofed-in space available in the 86 quay sheds erected out of public funds covers an area of 154 acres. Fifty-eight of these sheds possessing 87 acres of floor space are operated by the state, and twenty-eight of them possessing 67 acres of floor space are leased to private quay-operating and river-transportation organisations. 31 % of the goods arriving or leaving by the sea route in 1925 were handled on the quays provided with transit sheds, the figures for state-operated and privately operated quays being 18% and 13% respectively. Another 9% were transhipped on *Freiladekais* or by warehousing and industrial concerns, whereas the remaining 60% were transhipped in midstream.

The total movement of goods handled in the Port of Hamburg in 1925 fell short of that handled in 1913 by about 23%, but the amount of goods loaded and discharged on the quays nearly reached the pre-war figure. It is true that imports passing over the state-operated quays in 1925 were still 27 % below the 1913 figure, but the corresponding figure for exports shewed an increase of 42%, so that the total amount of goods handled by these quays in 1925 was only 13½% less than in 1913. Conditions were very similar as regards the privately-operated quays.

The fact that the space requirements of the quay-operating concerns are far greater now than they were in pre-war times although the volume of goods handled by them is actually 13½% less is partly due to the considerable increase in exports — which requires far more space than imports — and partly to other changes in regard to trade conditions which affect the port in a similar way and to which brief reference has already been made on page 100

The subjoined table illustrates the relative positions occupied by the various means used to convey the export and import cargoes to and from the state-operated quays in 1925 (the figures given in brackets being the corressponding figures for 1913).

Method of Conveyance	Export Cargoes	Import Cargoes
By Cart	45% (62%)	24% (13%)
By Rivercraft and Harbour Vessels	5% (5%)	52% (68%)
By Rail	50% (33%)	24% (19%)

The general outline of the practice adopted in the quay sheds for handling the cargo is as follows:

(a) Discharging. —The work of discharging is started as soon as the vessel —

of whose arrival the Quay Administration must be advised in good time by the shipowner or broker — has reached the berth allotted to her, her hatches having been cleared beforehand and the quay cranes having been placed in suitable positions. The necessary preparations in the shed are also made in advance with reference to the particulars contained in the ship's manifest, and proper accommodation is provided for each separate article. The number of cranes held in readiness and that of the gangs of longshoremen engaged depends on the instructions received from the broker, and the amount of mechanical equipment and the number of watchmen required are regulated accordingly. The Quay Administration takes charge of the goods after unloading. Valuables and goods arriving in a damaged condition may be kept free of charge in special lock-up boxes. After the cargo has been sorted, it is placed at the disposal of the consignees who must produce the bill of lading as evidence of their claims to be regarded as such. They are entitled to inspect the goods, to sample then, to have the packing mended if necessary, and in certain cases to have the merchandise re-packed. The goods are then delivered to them, either in bulk or in separate lots as they may desire, and their removal from the sheds takes place by cart or rail, or by river barges or harbour lighters that take up the position vacated by the ocean-going vessel after her discharge has been completed. Sometimes the cargoes are taken over by lighters whilst the work of discharging is still going on. In such cases the lighters lie near some other part of the quay, and the cargoes are not handled in the transit shed at all, but the rule is that they remain in them for a short period. In order to safeguard the public interest, demurrage is charged on all goods that remain on the quays beyond a fixed number of lay days, and in special cases compulsory warehousing is resorted to.

(b) Loading. — Commodities intended for exportation are accepted by the Quay Administration for delivery to the shed where the steamer concerned is berthed. There they remain piled up until the work of loading can start, and are grouped according to ports of destination. Such separation demands much valuable floor space, the more so because most of the export cargoes consist of package freight. It also necessitates the provision of regular places for collecting them, one or more for each steamship line. For these reasons it has been found useful in practice to assign fixed berths to regular liners even in the absence of binding agreements to that effect. Thus the main difference between shipping concerns that have leased one or more quays and those that have not done so is that the former operate their quays themselves, whilst the latter are served by the Quay Administration. Altogether about 190 collecting stations for an equal number of shipping services are now provided in the state-operated quay sheds. Tramp shipping, of course, does not benefit from this arrangement. Tramps are berthed wherever suitable accommodation happens to be available from time to time. Generally speaking, liners are discharged at the same sheds from which they are loaded.

In order to keep the number of collecting stations near deep water as low as possible, a special Exporting Shed has been built in Magdeburger Hafen. Similar purposes are occasionally served by Sheds No. 49 (Saalehafen) and No. 59 (Grenzcanal). The goods collected there are transferred to lighters by which they are conveyed to the ocean-going vessels direct, no matter whether these latter are berthed alongside some quay or in midstream.

Fig. 70. A Ferry Boat: Workmen returning to their homes.

Whereas the Quay Administration has no direct influence upon the lighterage and cartage concerns with which it cooperates, it exercises a large measure of control over the Port of Hamburg Railway *(Hafenbahn)*, which, indeed, is under its own management, although the locomotives, trucks, etc., are the property of the German National Railway Co. *(Reichsbahn)*. The latter, under the terms of an agreement concluded with the Hamburg State Government in 1888, is under the obligation to operate the train services, including shunting, on the harbour railroad tracks built by and belonging to the Hamburg Government. As the competent district offices of the National Railroad Company have their headquarters in the adjacent city of Altona, direct cooperatior between the two administrations is easily accomplished. The Port of Hamburg Railway, apart from connecting the manufacturing concerns of the port with the railway system, serves to convey goods between the ships' berths and the railroad stations, etc., of the lines converging upon Hamburg as described on pages 12 to 13. The handing-over of trucks from one administration to the other takes place at Hamburg-Süd or Kai-rechts, whilst the goods are transferred from the care of one to that of the other in the quay sheds.

Repeated reference has already been made to the fact that certain sheds are not operated by the Quay Administration, and have been leased to various shipping companies. The largest of the privately-operated quay services is that maintained at Kuhwärder by the Hamburg-Amerika Linie conjointly with its subsidiaries, the Lager- und Speditionsgesellschaft and the Kühltransit-A.-G. Nine of the largest sheds are thus operated by this company, viz., Sheds Nos. 69 and 70 on Kuhwärderhafen, 71 to 75 on Kaiser-Wilhelmhafen, and 76 and 77 on Ellerholzhafen. Thus the company has at its disposal a completely self-contained harbour of its own, possessing quays, quay equipment, three cranes for specially heavy loads, two coal tipping devices, large repair sheds, its own laundry, and its own office premises (on Reiherquai). The Lager- und Speditionsgesellschaft operates a transhipment and warehousing service in six additional buildings adjoining Sheds Nos. 69 and 70. Reference to the cold-storage facilities provided in this group of harbour basins will be found elsewhere (cf. page 70).

In addition to this large group of harbour basins, the Hamburg-Amerika Linie also uses the following buildings, viz., the Rhine Service shed on Johannisbollwerk; the Passenger Embarkation Halls on Strandquai, Grosser Grasbrook, and the Overseas Passenger Home *(Überseeheim*, cf. page 74) built by the Company near Müggenburger Zollhafen.

The other quay-operating services under private management use from one to four sheds. The second largest concern is that operated by the Hamburg-Südamerikanische Dampfschiffahrts-Gesellschaft by whom the three Sheds Nos. 45 to 47 on O'swaldquai (Hansahafen) and one crane for very heavy loads are used.

Approximately equal in extent is the service operated by the Afrika-Linien in Sheds Nos. 26 to 29 on Baakenhafen, occupying the whole length of Petersenquai, including repairing sheds near the upper end of the harbour basin.

The Deutsche Levante-Linie operates Sheds Nos. 41 and 42 on Amerikaquai (Segelschiffhafen), and has some repairing sheds as well.

Finally, Shed No. 57 on Afrikaquai (Indiahafen) has been leased to the Hugo-Stinnes-Linien which now, together with the Deutsch-Austral and Kosmos-Linien, form part of the concern of the Hamburg-Amerika Linie.

The five German lines enumerated above have leased the various state-built sheds, including the cranes and other equipment and the quay walls, from the Hamburg Government. The Royal Mail Line and the American Line, however, by whom Sheds Nos. 80 and 84 respectively are operated, have only leased the sites for these premises, the latter having been built by the state at the expense of the Lines.

Although the various privately-operated quay services employ their own longshoremen, and, generally speaking, their own stowers as well, and although they are exempt from any state interference with the conduct of their business, there is a great general resemblance between them and the state-operated service, because they are obliged to charge the fees fixed by the state. Moreover, the Quay Administration — as has been stated before — is entitled, in the event of these facilities not being utilised to their full extent, to assign for dispatch to the privately-operated organisations any vessels which it cannot accommodate at its own quays. The leased premises must not be used for any purpose except the discharging and loading of goods. Their utilisation, for instance, for warehousing purposes is not permitted. The extent to which they are made use of must not fall below the standard of efficiency set up by the state in respect of the state-operated sheds and other transhipment facilities. This condition is of paramount importance, because the ultimate responsibility for the proper utilisation of the harbour as a whole must rest — and must continue to rest —with the state.Such collaboration between state-operated and privately-operated quay services has proved eminently satisfactory in actual practice. The upkeep of the leased quays is looked after by the state at the expense of the companies or by the latter themselves subject to the control of the state.

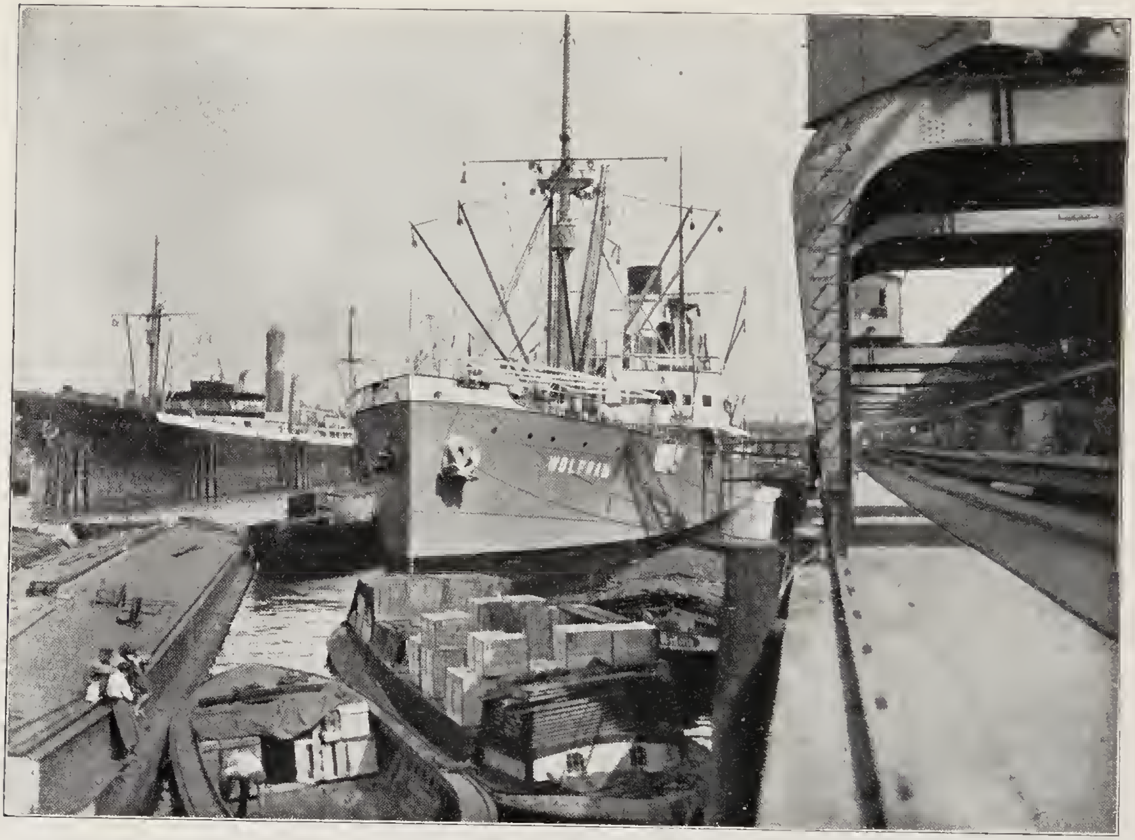


Fig. 71. The Quay of the Afrika-Linien, Baakenhafen (with Overseas Steamer, up-river Barge, and Harbour Lighters).

The Port Administration *(Oberhafenamt)* differs from the Quay Administration in that it is not really an operating organisation like the latter. Except in connection with a few cranes located near the fringe of the city, it has nothing to do with the transhipment of goods. Its duty is to maintain order and safety within the harbour from the nautical point of view, and to do so in conjunction with the Police Administration. In order to enable it to supervise the due observance of the port regulations, four Harbour Master's Offices *(Hafenämter)*, corresponding to the four districts into which the Port of Hamburg has been divided, are subordinated to it. Its chief function consists in the assignment of berths to all such vessels as do not make use of the quay installations, and in the supervision of the entire traffic by water. In particular, it is competent to look after that branch of the pilot service in regard to which the Hamburg state government is empowered to legislate, viz., the harbour pilot service.

Pilots are of three different kinds, viz., deep-sea pilots, river pilots, and harbour pilots. The two first-named groups are subject to the legislation of the national government. There is no compulsory pilotage between the mouth of the Elbe (as defined in a different section of this book) and Brunsbüttel (where the Kiel Canal links up with the Elbe), but vessels are bound to pay the pilot's fee all the same. Between Brunsbüttel and Hamburg, too, vessels are not compelled to engage a pilot, and for that section no fee is payable if no pilot is engaged. If the captain chooses not to avail himself of a river pilot (who, as has been explained on page 57, is sworn-in as a customs officer), he must either carry a special customs officer on board or have the ship's holds locked and have the customs seals affixed to them. The harbour pilot's competency starts at the harbour pilots' station (Seemannshöft, on Waltershof). Pilots are not compulsory in the harbour either, and no fee is charged there no matter whether a harbour pilot is engaged or not. The latter acts as an adviser to the captain and takes the ship up to the berth assigned to her by the Port or Quay Administration, as the case may be, or by the private quay-operating concerns. Harbour pilots are also available, if desired, when the ship changes one berth for another, and on her leaving the Port of Hamburg.

For the purpose of avoiding any delay to vessels whose arrival in the port is expected, and of making beforehand all the necessary preparations for their accommodation, a carefully organised information service has been established. The wireless messages sent from vessels when still in the North Sea are taken up by the Cuxhaven marine signalling station or by one of the lightships anchored near the entrance to the Elbe estuary, and are transmitted to the post office. The latter telegraphs the information to Hamburg where it is simultaneously received by the *Oberhafenamt*, the guardship berthed at the Jonas station, and the harbour pilots' station. It only takes the message seven or eight minutes to travel from Cuxhaven to Hamburg. It is contemplated to erect an additional signalling station at Brunsbüttelkoog near the entrance to Kiel Canal so that vessels proceeding in the direction of the latter, and not higher up the Elbe, may be eliminated from the information service, and that it may be possible to predict with greater accuracy the time when each vessel will presumably reach Hamburg. The quay-operating services advise the *Oberhafenamt* daily of the berths they have allotted to the ships whose arrival in the port is expected. A few days before such arrival the agent acting on behalf of the ship consults the *Oberhafenamt* in regard to the mooring posts (dolphins), or else the managenent of the quay-operating service in regard to the quay berth to be used for her accommodation.

The other functions carried out by the *Oberhafenamt* include the operation of the Johannisbollwerk and Vorsetzen quays (within Customs Union territory) in so far as they are not managed by private concerns; the collection of the fees payable for such work, viz., quayage dues and craneage charges; the superintendence of the Hamburg lighthouses and buoys, and the collection of the fees for using the public landing stages at St. Pauli, on Stadtdeich, and elsewhere. The office also takes charge of the customs insignia, i. e., the black and white customs ensigns and the white and green stern lights lent to vessels.

Fig. 72. Niederhafen.

An organisation in no way connected with the two authorities just referred to is the Harbour Construction Authority *(Hafenbaubehörde)*. The Hydraulic Engineering Board *(Wasserbaudirektion)*, although attached to the River and Harbour Construction Section of the Municipal Works Committee *(Baudeputation, Sektion für Strom- und Hafenbau)*, nevertheless closely cooperates with the various operating administrations, more particularly with the Quay Administration. It is responsible for the construction and the upkeep of the harbour, railroad, and traffic facilities described. Only a few of these are directly operated by this authority, their number including the locks, some of the movable bridges, the Köhlbrand train ferry, and the Elbe tunnel. Some structures within the harbour, but near the edge of the city, e. g., the Elbe bridges, have been built and are maintained by the First Section of the Municipal Works Committee *(Erste Sektion der Baudeputation)* which is in charge of the strictly municipal area.

For several centuries Hamburg also administered the Lower Elbe *(Unterelbe)*, her direct means of communication with the sea, including the waterways branching off from it within the area of her port. The functions concerned with such administration comprised not only the regulation work of the river, but also the erection and upkeep of lighthouses and other guides to navigation. The new German constitution, however, provides that the administration of the Elbe, like that of all other navigable German waterways used for the purposes of public traffic, is to be vested in the national government. The necessary transfer became effective on April 1, 1921. A branch section of the National Waterways Administration was accordingly established in Hamburg. The fact that this branch section is composed of members of the above-mentioned River and Harbour Construction Section and of the Committee for Trade, Shipping, and Industries *(Deputation für Handel, Schiffahrt und Gewerbe)*, and that, for the present, it will continue to be domiciled in Hamburg, justifies the latter in feeling confident that the new body will continue to pay due regard to her interests on the Lower Elbe after the transfer of the management to Berlin. The reach of the Elbe from Ortkathen, above Bunthäuser Spitze, to Blankenese remains subject to the direct administration by the Hamburg authorities, because it is so very closely connected with her port, of which, in fact, it constitutes an integral part.

The administration of the customs, which in the past was also looked after by Hamburg, has likewise been transferred to the national government in accordance with the provisions of the new German constitution.

The relations between the German National Railroad Company *(Deutsche Reichsbahn-Gesellschaft)* on the one hand, and the Hamburg state government and the various harbour-operating services on the other, have already been discussed in connection with the Quay Administration. In addition, however, to operating the Port of Hamburg Railway, the *Reichsbahn* also attends to the transhipment of goods, more especially coal and coke. For the purpose of transhipping them from the railway truck to the ocean-going vessel, the *Reichsbahn* operates, between Quay Shed No. 33 and the Distributing Shed on Kirchenpauerquai, a coal transhipment quay (cf. Section III) equipped with a coal tipping device built by the Hamburg state and leased to the railway company, and with several automatic grab cranes. For the transfer of coal and coke to barges and lighters the company operates its own coal yard provided with efficient equipment similar to that just described. It is located near Hofecanal, Peute. The company also operates a third waggon-tipping device for coal and coke on its Hamburg-H station near Oberhafen-Kanal. Its *Freiladekai* there, like the corresponding quays on Oberhafen and Ericusgraben, is provided with up-to-date crane equipment by means of

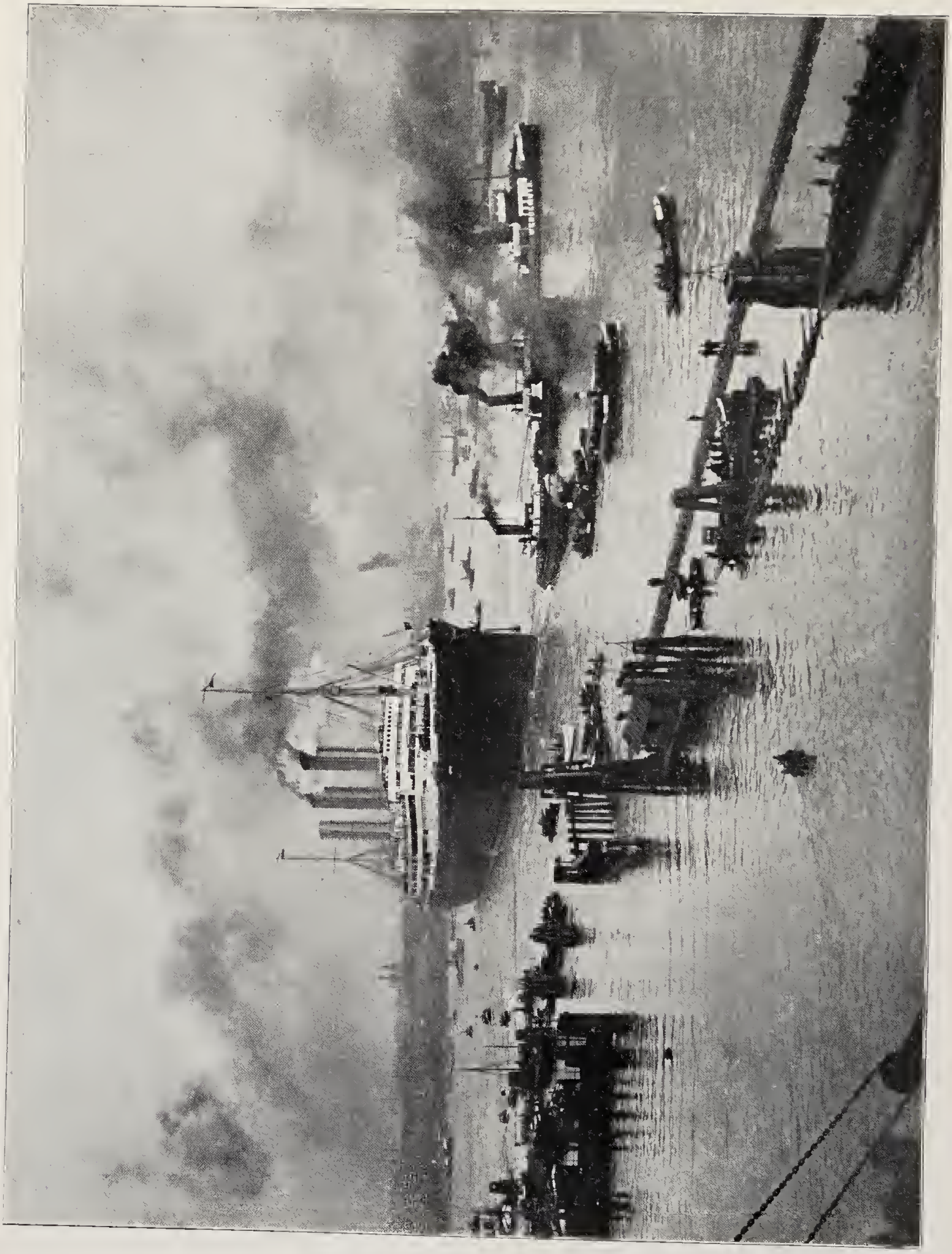


Fig. 73. An outgoing Steamer.

which not only coal and coke, but also certain other kinds of goods, can be transhipped from rail to river barge. Altogether, there are available fifteen 5-ton cranes and one 30-ton tower slewing crane. Thanks to these facilities, the share of the *Reichsbahn* in the total transhipment business of the Port of Hamburg is by no means inconsiderable.

Most of the warehousing business in the Port of Hamburg is organised on the lines of a "mixed" concern. An agreement concluded in 1885 between the government and the Norddeutsche Bank in Hamburg provided for the establishment of the *Hamburger Freihafen-Lagerhaus-Gesellschaft* which, as its name indicates, devotes its activities to the greater portion of the warehousing business carried on within the free-port section of the harbour. Although it is outwardly constituted as a limited liability company, the state is very largely interested in it. The three state representatives on the board, as well as the Senate, are entitled to veto any resolutions carried by the board, and the state also participates in the net profits earned inasmuch as it receives a certain percentage of the latter in the shape of a rental, whilst an additional part is set aside to provide a fund for the purchase of the company's shares by the state. In this way all shares will eventually become the property of the latter, and when that has happened, the lease agreement will automatically expire. The road, canal, and rail connections on the leased property were provided by the state, whereas the buildings were erected by the company subject to the approval of the former.

The charges made for letting warehousing space, for warehousing, and for attending to the warehoused merchandise must also be submitted to the state for its approval.

The company started its activities in 1889, i. e., shortly after Hamburg had joined the Customs Union. The buildings then available were subsequently added to until the present stage of development was reached. They cover a total area of 26 acres, and will possess floor space amounting to 126 acres when the two warehouses now building are completed. The last-named figure represents about 60% of the total warehousing space (200 acres) available in the Port of Hamburg. About 70 out of the above-mentioned 126 acres have been let to merchants and to warehousemen for office and warehousing purposes, whereas the remainder is used by the company itself, whose activities are not restricted to warehousing, but also include sorting, marking, re-packing, testing, etc. The company has been authorised by the government to issue negotiable warehouse receipts (warrants) to order. The total volume of the warehousing business transacted by the company during 1925 is illustrated by the fact that about five million packages, of a weight of 340,000 tons, were handled by it. High-class goods, such as coffee, cocoa, tea, tobacco, etc., are principally warehoused in the warehouse city near the Zollcanal in the northern section of the free-port area, but bulk goods like cotton, jute, hemp, ore, etc., are stored in the section south of the Elbe on Melniker Ufer and Dessauer Ufer.

*

Private Organisations and Occupations connected with the Harbour Services.

All other warehousing concerns in the Port of Hamburg are entirely privately operated. About 80 acres of additional floor space are available for their requirements.

The biggest of these firms are Messrs. Nathan, Philipp & Co., and Messrs. Eggers, Wright & Co. The latter firm — whose extensive premises are situated on Reiherstieg — is typical of the numerous concerns exclusively devoting themselves to warehousing. Messrs. Nathan, Philipp & Co., on the other hand, occupy a special position inasmuch as they engage in quay-operating, warehousing and industrial activities alike. The four separate sites leased by them cover a total area of obout 75 acres and are adjacent to water sufficiently deep to allow access to sea-going vessels. The newly-built quay-operating and warehousing premises of the firm occupy the greater part of the east bank of Grenzcanal. Their warehousing capacity is about 150,000 tons. They are exclusively used for warehousing purposes. The second site leased by the firm is directly adjacent to the southern bank of the main Elbe on Steinwärder. It contains several industrial installations, viz. a mixing plant for farinaceous fodders, a drying plant for kernel fruit, oil fruit, oil cake, and fodder, and grinding mills for numerous kinds of merchandise including, among others, graphite, antimony, magnesite, caseïne, tannine, fish meal and other fodders. These premises are, as a rule, not used for warehousing purposes except in conjunction with their mechanical treatment. The third site is located on the west bank of Grenzcanal, and is exclusively used for discharging, storing, and loading precious woods. The fourth site, on Petroleumhafen, is provided with three berths where vessels can be accommodated, and contains 62 tanks capable of holding about 120,000 tons of mineral oils, etc., of all kinds.

An occupation akin to warehousing, but in a sense peculiar to Hamburg, is that of the *Quartiersleute*. Their origin dates back to a time when it was the custom for every firm to have its own warehousing premises — a custom to some extent still adhered to in the city proper. Some firms employed their own so-called "house coopers" *(Hausküper)* who attended to their principal's warehousing needs including the storage, sampling, and packing of the goods, their transportation after sale, and all minor operations connected with this work, but others engaged the services of the *Quartiersleute* for these purposes. As a rule, four *Quartiersleute* used to carry on business together, and this circumstance is supposed to explain their name. They enjoyed the special confidence of their employers, which often went so far that they were sent abroad to transact important business for them. Nowadays, however, the special character of this ancient Hamburg profession has lost most of its peculiar features. The name *Quartiersleute*, indeed, has been retained, but for the most part it now denotes large firms organised along business lines. Some of them — especially those domiciled in the City, but also some of those carrying on their business in the free port — have their own warehouses, but the majority use premises rented from the Freihafen-Lagerhaus-Gesellschaft, and apply themselves not only to warehousing, but also to a number of other services directly or indirectly connected with it. Several of the largest firms of *Quartiersleute* carry on transport organisations and have their own tugs, carts, lorries, etc.

Coopers *(Küper)* are engaged by the *Quartiersleute* to prepare and mend the packing, although cooperage is also carried on as an independent occupation. The name goes back to the days when most of the goods were shipped in wooden casks, and when the work of mending any defects in them was sufficiently important to give employment to a special class of workers. In our days, of course, coopers are qualified to give expert treatment to any kind of packing, and we meet them both in warehouses and in transit sheds.

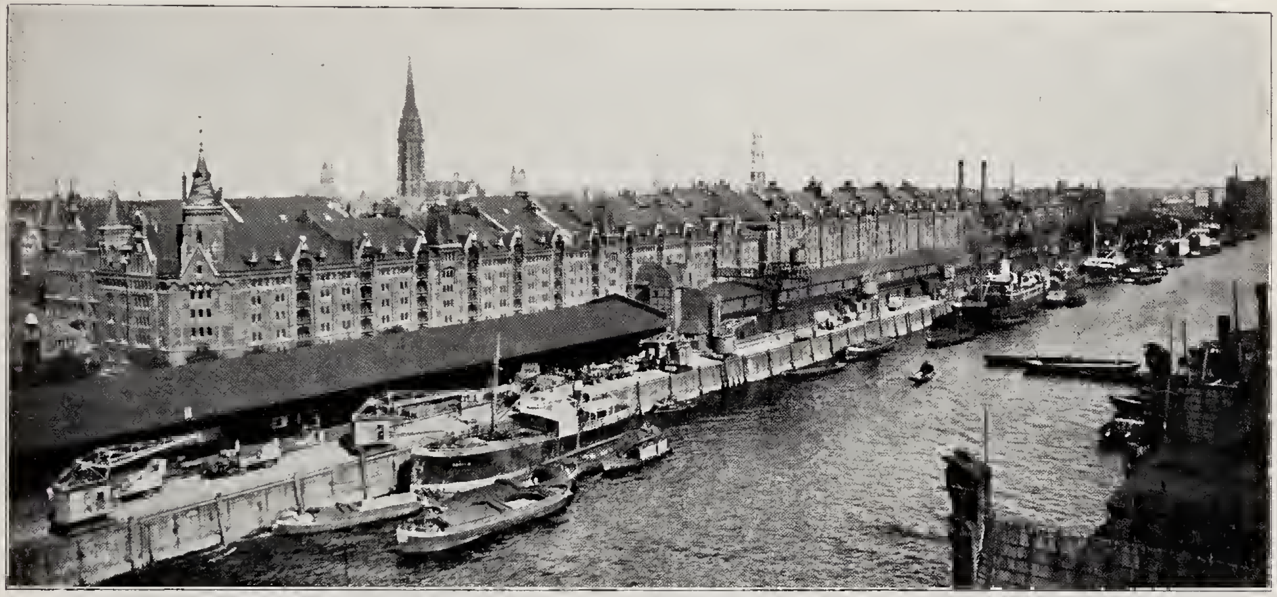


Fig. 74. Sandthorquai and the Warehouse Town.

One of the most important private occupations carried on in the harbour is that of the shipbroker. In Hamburg not only those shipping firms that have their head offices outside Hamburg, but also most of the local ones are in the habit of employing shipbrokers for the purpose of seeing to all matters connected with overseas shipping. It is true that a few local shipowning concerns habitually deal with shippers, public authorities, etc., direct, but even they usually restrict this method to certain definite services run by them, and their doing so is felt so much to be an exception to the rule that they are spoken of as being their own shipbrokers. In the case of very large shipowners the shipbroking business is sometimes specialised to such an extent that the company's outgoing and incoming freight business is looked after by two different brokers. Shipbrokers — except, of course, those that do business for "trampers" — usually work under a contract with the firms that employ their services. In addition to the purchase, sale, and chartering of vessels, they are chiefly instrumental in drawing up the freight contracts between shipowners and merchants. The result is that — apart from the few more or less isolated cases referred to above — merchants and shipowners do not deal with each other direct. Both sides profit from the shipbroker's professional experience, which makes him an expert concerning cargo requirements as well as matters demanding a knowledge of market conditions — both matters with which, as a rule, either the merchant or the shipowner is not familiar. As the shipbroker also attends to all questions connected with the arrival and departure of vessels, including their clearance through the customs both inwardly and outwardly, it follows that the port authorities, too, have mostly to deal with him, and not with the owner himself. It is evident, therefore, that the practical knowledge shipbrokers accumulate in the course of their experience is a valuable asset to a seaport, and particularly to one like Hamburg. There are two classes of shipbrokers in the Port of Hamburg, viz., those attending to ocean-going vessels and those attending to up-river vessels.

Another occupation that plays a large part in the handling of vessels in the port is that of the stevedore. The stevedoring work is entirely carried out by private firms — there being some large ones and numerous small ones — specialising in many different ways. Generally speaking, such shipping companies as operate their quays themselves employ their own stowers to the exclusion of outside firms. In the case of vessels loaded and discharged in midstream, the stevedore is in sole control of operations, but when transhipment is effected *via* the quays, he has to adjust his methods to those employed in quay operation. So long as the cargo to be unloaded is on board the vessel, the stevedore is in charge of it, but as soon as it is suspended from the crane hook, the work of the longshoremen begins. The stevedore also supplies all the tackle required for fastening the loads to the crane, unless the shipowner does so himself. He receives his instructions from the shipowner or from the shipbroker, but the quay administration has no influence concerning the choice of the stevedoring firm to be employed. As the stevedoring companies, when operating in midstream, attend to the whole of such transhipment business themselves, the larger firms among their number possess all the appliances that are more or less indispensable for such work, e. g., floating elevators for the transhipment for bulk goods. Special mention should be made in this connection of the Getreideheber-Gesellschaft, which owns 18 floating elevators besides operating four additional ones on behalf of the Hamburg-Amerika Linie, and of the various coal transhipment and bunkering concerns, particularly the Neue Kohlenheber-Gesellschaft and the Kohlen-Stauerei-Gesellschaft which attend to the discharge of coal shipped by seagoing vessels, and which employ loading bridges and floating coal elevators for this purpose.

In connection with transhipment reference should also be made to the grain factors. Their German name *(Kornumstecher)* is connected with the fact that it was their business to re-stack every now and then the grain stored on the warehouse floors with a view to proper ventilation. Nowadays they act as a kind of confidential agents of firms to whom shipments of grain and similar commodities are consigned. One person connected with every firm of corn factors — which must not be the owner — acts as a sworn weigher. Corn factors may be compared with the *Quartiersleute* inasmuch as they attend to the sampling and forwarding of the goods as well as to their weighing.

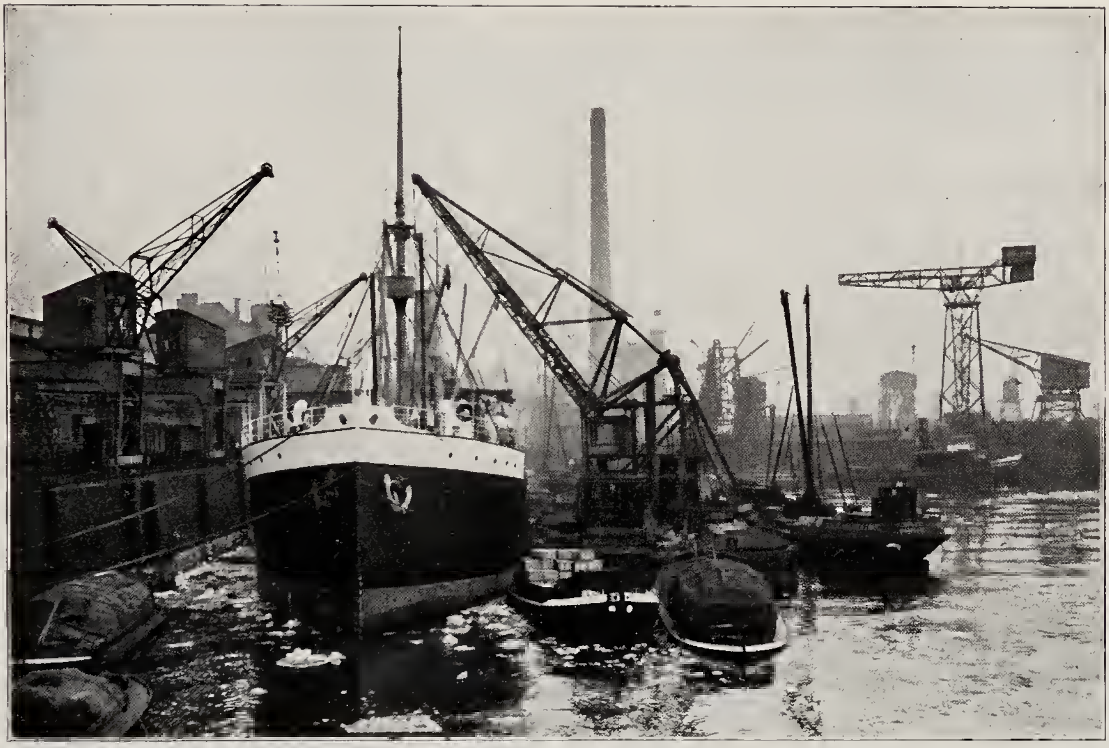


Fig. 75. A Floating and a Stationary Crane for heavy loads.

The interests of consignors of grain, fodder, and seed cargoes are looked after by the Controll-Co. m. b. H., an organisation represented at most European seaports.

The shipowners, in their turn, engage the services of special cargo checking firms which provide the necessary tallymen, so that the cargoes, during their loading or discharging, are checked twice, viz., by the special tallymen just referred to and by those employed by the quay-operating organisations.

If consignees prefer not to avail themselves of the facilities for weighing offered by the Quay Administration, they may employ private firms of cargo superintendents instead, who supply their own weighing machines and weigh the cargo on the roadway between the water's edge and the transit sheds or in some other suitable place. To some extent, however, the function of weighing falls within the scope of the *Quartiersleute.* The weights of grain cargoes and the measurements of timber cargoes are checked by special grain and timber superintendents sworn-in by the Hamburg Committee for Trade, Shipping, and Industries *(Deputation für Handel, Schiffahrt und Gewerbe)* and controlled, in their turn, by the Chamber of Commerce *(Handelskammer).* Other superintendents of weights and measurements are sworn in by the customs authorities. They act in lieu of the competent customs officers in the case of goods which, for the purpose of facilitating trade, are to be weighed or measured before their actual clearance through the customs outside the customs stations.

The nautical experts appointed by the Chamber of Commerce for periods of three years at a time are sworn in and controlled in like manner. They are qualified and authorised to give expert opinions concerning stowing and dunnage matters and on nautical matters generally, but their work does not include that carried out by the ship's appraisers which consists in appraising the value of ships, average losses, etc.

The important business of dealing with the local traffic in the harbour area is also looked after by private firms. The Hafen-Dampfschiffahrts-Gesellschaft, for instance, runs various ferry-boat services as well as some passenger services to Lower Elbe destinations. Local transportation of goods is attended to by the barge and lighter owning firms, whose business is spoken of in Hamburg as *Ewerführerei*, although the term *Ewer* is not usually employed to denote a barge or a lighter (Real *Ewers* are shewn in Fig. 5, whereas the harbour lighters used by the *Ewerführer* are illustrated in Figs. 60 and 63. A comparison shews that the two types of vessels are entirely different). Some of the lighterage firms also own tugs, whilst others have extended the scope of their business so as to include cartage as well. Other branches of the waterway traffic in the port are looked after by tug owners possessing and employing tugs of all sizes, and by launch owners who place their vessels — most of which are driven by motor power — at the disposal of the public at rates charged by the hour. Transportation of goods on land, of course, is looked after by carters and cartage concerns.

We cannot close this enumeration without making brief mention of the ship and boiler cleaners, the dealers in ballast and fresh water, and the ship fasteners. The latter's business consists in securing vessels to quay walls by means of ship's hawsers, etc.

The preceding account gives some general idea of the diversity of the services performed in the Port of Hamburg and shared in by an endless number of concerns, ranging in size from the largest to the smallest, but all of them collaborating down to the minutest details for the benefit of the whole organisation.

★

Employment Conditions in the Port.

The relative importance of the various services and occupations carried on in the port finds its expression in the employment statistics. The following figures shew the average numbers of workmen employed during each of the past five years.

Quay-operating services	up to	9,000
Stevedoring	,, ,,	6,000
Lightering	,, ,,	2,000
Warehousing	,, ,,	1,400
Waterway traffic	,, ,,	1,300
Ship and boiler cleaning	,, ,,	1,200
Cargo superintending	,, ,,	700
Coal transhipment	,, ,,	500
Grain factors' work	,, ,,	200
Total:	up to	22,300

To this number should be added the 34,000 industrial workers to which reference has already been made on page 66, and also the men engaged in the building trade, the officials, the clerical employees and certain others, so that we are probably right in fixing the grand total of persons carrying on some kind of occupation directly connected with the harbour at about 70,000 or 80,000.

Fig. 76. Baakenhafen (shewing the Double Cranes on Versmannquai).

A special organisation is needed to distribute the labour available in the harbour as conveniently and economically as possible, more particularly so in view of the fact that the employment conditions in the various occupations and services are practically never the same from one day to the next.

The state-operated services have at their disposal a permanent stock of men in regular employment supplemented by others engaged by the day for occasional work as required. A good many of these workers are in possession of so-called "priority tickets", and as these men have proved suitable in the past, they are entitled to preferential treatment when they apply for work.

By far the greater number of privately-operated concerns have their joint labour exchange *(Hafenbetriebs-Verein)*. The functions of this organisation, however, are not restricted to matters concerning employment. It has, in addition, a certain influence upon the methods of operation adopted by the various services, and the Harbour Operating Regulations *(Hafenbetriebsordnung)* issued by it — regulations which are binding upon all harbour services, including the State Quay Administration — have greatly helped to increase the uniformity, punctuality, and regularity with which these services are conducted.

★

The Harbour Fees charged by the State.

By way of concluding this section a few remarks on the harbour dues may not be unwelcome to readers, even though, of course, it is impossible to go into many details concerning them. Seeing that a large number of state and privately-operated organisations have a share in the work performed, it stands to reason that the subject of the fees they charge for their services is a very intricate and complicated matter. All that can be done in this context is to present a very general outline of the tariffs fixed by the state for the use of the port facilities available to the public.

Every sea-going vessel upon entering the harbour is charged a harbour fee *(Hafengeld)*. It is calculated on the net tonnage of the vessel expressed in cubic metres. Reduced rates are payable by small sailing and motorships; by sea-going vessels engaged in the Baltic and North Sea trades (including Norwegian, British, Irish, and French ports as far as Le Havre); by vessels carrying bulk goods of low commercial value; by vessels not arriving from the sea at all or arriving from the sea in ballast, but proceeding seaward loaded with cargo, and finally by vessels whose cargoes were exclusively taken aboard in German ports.

Vessels taking up their berths alongside the quay for the purpose of loading or unloading have to pay quay charges *(Kaigebühren)*. Tonnage dues *(Raumgebühr)* are charged for each lay-day according to the net tonnage expressed in cubic metres. No tonnage dues are payable by vessels exclusively loading goods discharged from other vessels alongside the same quay. Vessels trading between none but German ports pay 50% of the full amount of the tonnage dues, vessels from which goods are directly transhipped to the railroad or *vice versa* pay 20%, and sailing vessels and sea-going lighters without motordriven lifting gear 10% only. For the actual transhipment of the goods passing over the quay so-called transhipment charges *(Umschlagsgebühren)* are payable, partly by the representatives of the vessel, and partly by those of the cargo as fixed by tariff. The charges are made for every 100 kilogrammes. They are graded according to the nature of the goods, a distinction being made between five different classes of the latter. Different rates apply to exported and imported goods, to shore and water transhipment. The charges made on imported goods transhipped on shore are slightly higher than those payable for transhipment by water. No such distinction is made in the case of exported goods, the rates for which are the same as those charged for imported goods transhipped on shore. Certain classes of exported goods are entitled to a reduction of the transhipment charges if a direct transfer between rail and sea-going vessel takes place. Goods are allowed to lie in the quay sheds free of charge for two days. The fees payable are quadrupled if the merchandise is not removed six days (incoming cargoes) or twelve days (outgoing cargoes) after the lapse of this period, in order to prevent the goods from unnecessarily occupying quay space. A weighage charge *(Wiegegeld)* is made if goods are to be weighed during their transhipment. This charge is increased if the goods are weighed in single lots or without their means of conveyance. Increased rates for weighing are also payable during the storage of goods. Special crane dues *(Krangelder)* are charged for lifting and lowering heavy single pieces ranging in weight between 2,500 and 150,000 kilogrammes, there being five different grades according to the weight of the articles. A reduction is allowed on large numbers of such pieces handled consecutively. Extra charges are incurred whenever application is made for the deferred handling of consignments intended for export, and for dividing consignments shipped on one and the same bill of lading. Additional rates are payable in respect of over-time, Sunday work, and night shifts (second and third shifts). Services of special kind are charged for according to the number of men engaged. There are various other charges besides those mentioned above, but they are of less importance and cannot be enumerated here for reasons of space.

The shipowner, in addition to paying his share of the quayage dues, has also to pay the expenses arising out of the stevedoring work in connection with the transhipment of the goods.

All goods arriving or leaving by the sea route — except imported coal — are carried free of charge by the Port of Hamburg Railway *(Hafenbahn)*. On all other goods a transport charge is made.

Compared with the pre-war figures, the increase in the quayage dues has been much less than the corresponding increase in wages. Before the war the wages of a longshoreman, for instance, ranged between Marks 4.00 and 5.30 for a nine (or nine-and-a-half) hours' shift, whereas the present average for an eight hours' shift is Marks 7.60, so that there has been an increase from 67 to 120%. The average rise in the cost of materials may be set down at 60%. The quayage dues, on the other hand, have only been subjected to an average increase of 35 or 40%.

SECTION SIX.

The Course of the River Elbe from Hamburg to the Sea.

The Upper, Northern, and Southern Elbe.

The River Elbe has at all times played a prominent part in the development of the Port of Hamburg inasmuch as it has always been the carrier of an enormous volume of traffic, both from the sea and from the hinterland. The interests of Hamburg, therefore, demand that this important highway should be permanently maintained in such a condition as to be of maximum use to her shipping. The value of the river naturally depends, to a large extent, upon the adequacy of the water supply that reaches the Port of Hamburg from the upper parts. Accordingly, the attention of the city fathers was drawn, at an early age, to that particular spot where the Elbe divides into two main branches of which one only, viz., the Northern Elbe *(Norderelbe)* flows past Hamburg, whilst the other, the so-called Southern Elbe *(Süderelbe)* flows past the Prussian city of Harburg. The original configuration of the land and water area enclosed by the two branches had to undergo numerous changes before it became what it is now. Many difficult pieces of hydraulic engineering work had to be carried out and many even more difficult negotiations had to be conducted between Hamburg and the other riverain states, viz., the kingdom of Hanover at first, and Prussia later on. The present condition of this area, therefore, can be best understood in connection with its past history, of which the present section is intended to give a rough outline, the historical development of the port itself being treated elsewhere in this book. The accompanying chart of the River Elbe[1], shewing its course from Geesthacht to Cuxhaven, drawn to a scale of 3.15 miles to an inch (1 : 200,000), may be helpful towards a proper under-

---

[1] The colouring used on the accompanying Chart of the Elbe, which should be referred to in connection with this section, is intented to indicate the following particulars.

Red: Alluvial soil *(Marsch)*. Light tint: area protected by dykes, medium tint: area not protected by dykes, dark type: area belonging to the city-state of Hamburg.

Brown: Diluvial soil *(Geest)*. Light tint: area belonging to Prussia, dark tint: area belonging to Hamburg.

Blue: Water Spaces. Light tint: above the level of Hamburg Zero, medium tint: from H. Z. to 6 metres below H. Z., dark tint: more than 6 metres below H. Z. (N. B.: The mean high-water mark lies 5.10 metres above H. Z.).

Red line: Interstate boundary between Hamburg and Prussia.

The meanings of the yellow, red, and green sectors of the beacon lights have been explained in the text. This chart, like the harbour plan, has been designed in accordance with the usual practice. Hence, the arrow indicating north points towards the bottom margin.

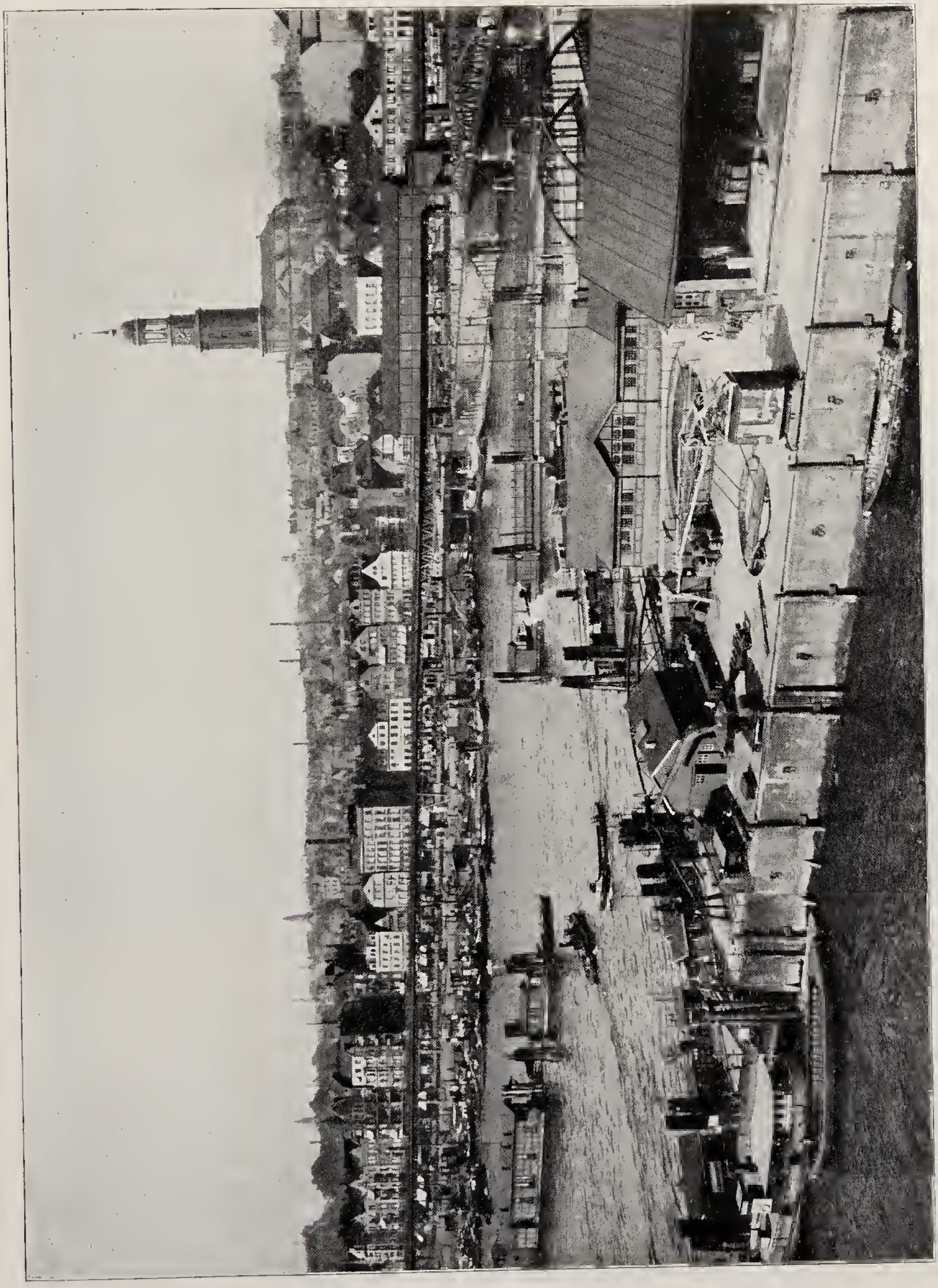


Fig. 77. Sandthorhöft with Landing Stage, Niederhafen with Floating Customs Palisade, Vorsetzen with Elevated Railroad, and St. Michael's Church in the background.

standing, as may also be the historical plans of the Port of Hamburg (as it was in 1865, 1885, 1905, and 1925) on Map No. VI.

The Hamburg township of Geesthacht marks the limit up to which, under normal conditions, the effect of the tides makes itself felt, although tides raised by exceptionally heavy gales extend even higher up the river. The velocity of the current at Geesthacht, according to the level of the water, varies from 2 ft to 4 ft 5 ins a second, the normal figure being 2 ft 4 ins. Consequently, the fall of the current varies between 1 : 13,000 and 1 : 7,000 (normally 1 : 8,000), and the quantity of water moving down the river ranges between 4,600 cu. ft. and 140,000 cu. ft. (normal quantity: 18,000 cu. ft.). Conditions, of course, are different within the section affected by the tides. At Bunthaus, for instance, the average velocity of the incoming tidal current is about 10 ins a second, whereas that of the outgoing tide is about 2 ft 8 ins.

The figures just quoted shew that even in our days the condition of the river — as far as it affects navigation and the maintenance of a regular channel — is largely subject to elemental influences. These influences, however, were far more potent before the river had been compelled to adhere more or less to a definite course.

The work of regulation was started at a very early date. During the Middle Ages the city of Hamburg was separated from the principal course of the Elbe by an archipelago of islands intersected by numerous branches of the river, all of them more or less useless for purposes of shipping. Direct connection with the main river, however, was gradually established by a number of cuts through the intervening islands , and thus a foundation was laid for the future development of the harbour. The principal improvements of this kind were made in 1258, 1482/90, 1492, 1550, 1570, and 1603. The outcome was that, at the end of this period, the northern branch of the river — now called Northern Elbe — occupied very much the same bed through which it flows to-day. The other branches, with the exception of the Southern Elbe and the Reiherstieg, gradually silted up, and the minor ones disappeared altogether when the groups of islands formerly separated by them were dyked in. The course of the river as thus modified by the interference of man was maintained intact by various isolated construction works of a protective character.

It was not, however, until the middle of the nineteenth century that the need for a more systematic regulation of the river made itself felt, and after prolonged negotiations with Prussia the so-called First Köhlbrand Agreement was concluded in 1868. As is indicated by the name, questions concerning the Köhlbrand (the lower reach of the Prussian Southern Elbe) and its future development, formed the principal subjects dealt with by the agreement. The chief provisions mutually agreed to were: (1) the river construction work at Bunthäuser Spitze was to be enlarged by increasing its length by 1,150 feet; (2) the width of the Southern Elbe at that spot was to be fixed at 920 and that of the Northern Elbe at 660 feet; (3) the course of the Northern Elbe was to be straightened out by a cut, about a mile and a half long, through the peninsula of Kaltehofe, which would shorten its course by about 3,000 feet and considerably improve the condition of the current; (4) the Dove Elbe was to join the main river above the Kaltehofe cut, and (5) the whole of the Northern Elbe was to be provided with protective works on shore and with dams parallel to the shore intended to provide a suitable channel navigable at medium and high water.

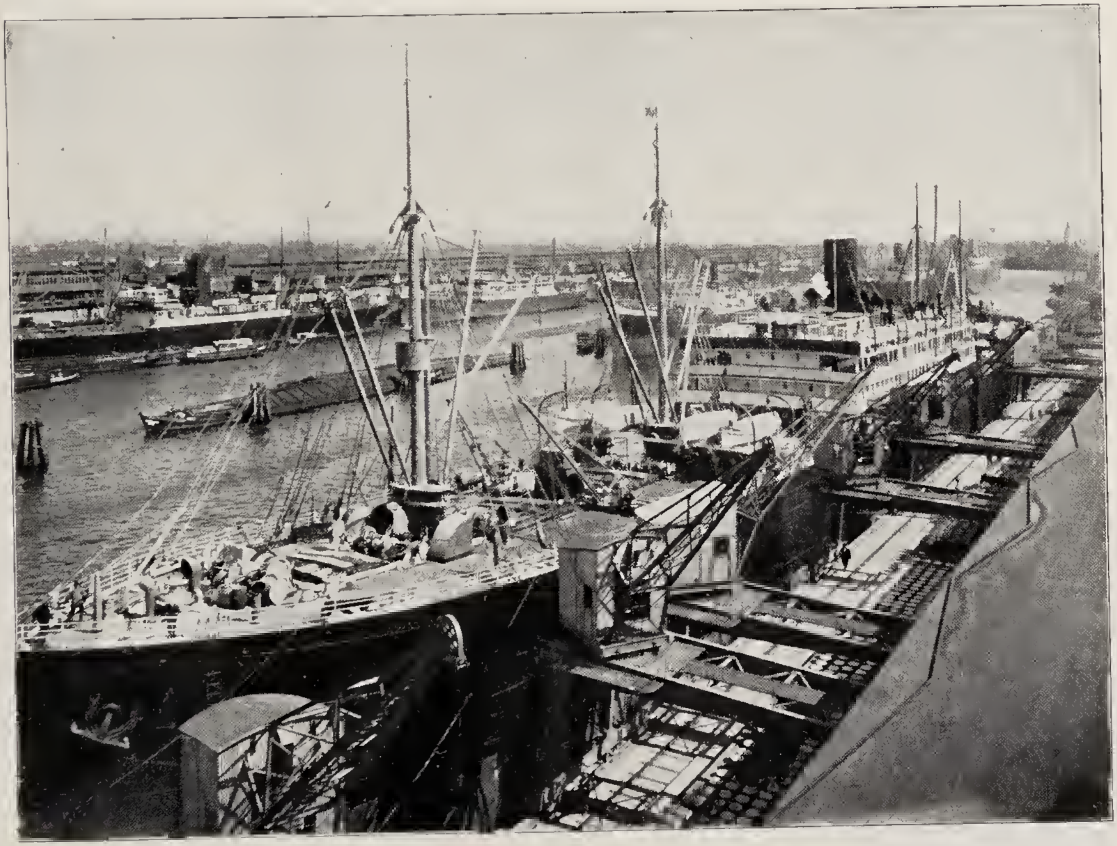


Fig. 78. Kronprinzquai, Kaiser-Wilhelm-Hafen.

Subsequently, in 1896, a supplementary agreement (Second Köhlbrand Agreement) had to be concluded with Prussia. Under its terms both parties were given a free hand in fixing the depth of the navigable channel of the upper reaches of the Northern and Southern Elbe respectively — which, until then, had been subject to certain restrictions. Other provisions contained in the agreement concerned certain improvements to be made in the Lower Elbe *(Unterelbe)*, to which reference will be made later on. For the present we shall continue our description of the schemes for the regulation of the Northern and Southern Elbe only.

The position established by the 1896 agreement was not such as to ensure that Hamburg received her full share in the control of the river — a matter of cardinal importance to her in regard to the unrestricted development of her port. This defect, however, was remedied by the Third Köhlbrand Agreement (1908) which contained some provisions very closely affecting her port and her river. It was agreed that the work at Bunthäuser Spitze should be further extended by another 1,300 feet, and that the width of the Southern Elbe, like that of the Northern branch, should be fixed at 660 feet, so that both branches were to receive equal quantities of water. With a view to utilising to best advantage the water supply diverted to the Northern Elbe, the lower course of this branch was to be widened, and it was agreed that it should be 1,000 feet wide at the spot where it entered the harbour area. The 1908 agreement also provided for an alteration of the entrance to the Köhlbrand which, until then, approximately coincided with what is now Kohlenschiffhafen. The angle at which the Köhlbrand then joined the main river was of such a nature as to unfavourably affect current conditions, and it was decided that the resulting inconvenience should be done away with by reducing this angle and by moving the confluence of the two waterways to a point slightly to the west. By the building of a long dam the newly created basin of the Kohlenschiffhafen was separated from the Köhlbrand mouth altogether. The same agreement also stipulated that the Köhlfleth and two minor branches of the Köhlbrand which formerly intersected the area now occupied by the island of Waltershof were to be dammed up to a height exceeding the highest levels ever reached by the tides. Owing to the radical alterations made in this newly added division of the harbour, not even a trace is now left of the two minor branches just referred to (Cf. the historical harbour plans of 1905 and 1925).

The next chapter will contain a description of the regulation work carried out on the Lower Elbe, i. e., the section of the river between the mouth of the Köhlbrand and the sea.

★

The Lower Elbe.

Between Hamburg and Cuxhaven — a distance of about 62 miles — the course of the river resembles a somewhat elongated S-shaped curve the apexes of which are at Lühersand and opposite Freiburg. Owing to this relative straightness the work of regulation presented less difficulties than that of improving the courses of rivers with numerous bends in their lower reaches. The difficulties confronting the hydraulic engineer in the case of the Lower Elbe arise from the fact that the current incessantly changes its direction in accordance with the tides. The result is that it invariably attacks different parts of the concave river bank, that the channel exhibits a tendency to divide into branches, and that the river bed is subject to frequent alterations of its shape owing to shifting sands. The last-named drawback is particularly troublesome owing to the extreme width of the river which, up to Finkenwärder, is much more like a deep inlet of the sea than like an inland waterway. The river bed, therefore, and more especially the deep channel below the mouth of the Lühe (down to which the work of regulation has been completed), is still somewhat irregular in its outline, although, generally speaking, the work of regulation has brought about the desired degree of stability. Since, however, it was essential that the traffic moving to and from Hamburg should be protected against all possible risks, an elaborate system of marking the fairway by buoys, beacons, and lights had to be added as well. The earliest endeavours of Hamburg in this direction date back to the Middle Ages: indeed, the practical interest she took in the improvement of her river was originally confined to such marking.

On the other hand, the necessity of deepening the channel of the river did not arise until centuries afterwards. At first the existing depth was quite sufficient for the needs of the small vessels of those early days, even in places where the water was particularly shallow. As time went on, the draught of vessels gradually increased, so that they had to wait for a high tide before they could pass certain sandbanks that obstructed their progress, but people were in no hurry in those days, and the delay did not matter.

In our own days, however, ships can no longer put up with such loss of valuable time. Even the practice of lightering on the lowest reach of the Elbe — to which recourse had been taken when the need arose — could not be considered entirely adequate. Hamburg had to solve the problem of how to enable even the biggest ocean liners to reach her port without delay whilst proceeding up the river, and the present chapter is intended to describe the various stages by which she attempted to do so.

Prior to the advent of the steamship on the Lower Elbe it was the custom of most ships having a draught exceeding 13 feet to wait for the rising tide off Neumühlen or Wittenbergen, or to lighter there, whenever the water was very shallow owing to the low tide. The sandbanks near Blankenese were the worst obstructions to shipping on the Elbe, because they were only from 5 ft 6 ins to 6 ft 6 ins below the surface at low water, and from 13 to 14 feet at high water. This state of things became entirely impracticable when steamships began to replace sailing vessels in increasing numbers. The first steamer to arrive in Hamburg (1816), a British vessel, was soon followed by others, but regular services were not established until about 1825. Quick despatch, however, is, and always has been, absolutely essential to all steamship services. After several ineffectual attempts to get rid of the obstructing sands by some primitive method of dredging, Hamburg, in 1833, resorted to the use of steam dredgers, and since then the work of dredging the Lower Elbe has made very considerable progress. The systematic dredging work carried out since the middle of the past century led to results that were at first completely satisfactory. This is shewn by the following figures stating the maximum draught of vessels able to reach the Port of Hamburg at high water in the years named, viz.:

about	1840	1859	1869	1879	1889	1897
	14 ft	17 ft	19 ft	22 ft	24 ft	26 ft

This, however, was the limit up to which permanently successful results could be obtained by dredging alone. The present achievement, viz., a depth of 40 ft below high-water, could only be brought about by the more comprehensive methods described below. A subsidiary problem that arose in conjunction with the work of deepening the navigable channel of the river was how to dispose of the dredged material. To transport it over long distances was out of the question owing to the expense it would involve, so that suitable near-by areas had to be provided where it could be deposited. The sand dredged in the harbour was found very useful for the work of raising the level of the harbour area and of the industrial districts in course of development higher up the Elbe, for filling-in the spaces in the rear of the pier walls and for enlarging and levelling-up the Finkenwärder foreshore. Lower down the river, however, where the latter flows through Prussian territory, suitable areas had to be purchased or leased from the Prussian Government.

Although dredgings on a very large scale provided the required depth of water, it was soon found that the maintenance of such depth by dredging alone, owing to the peculiar conditions of the current, would be impossible — or, at any rate, ecconomically unsound. This was one of the considerations that caused the work of regulating the course of the river to be taken in hand, a commencement being made with the Northern Elbe.

The regulation work of the Lower Elbe proceeded step for step in a downstream direction. A start was made (1897) in the Altona-Nienstedten reach of the river after the conclusion of the second Köhlbrand Agreement and in pursuance of its terms. Within five years the navigable channel was widened, straightened out, and regulated. The former mouth of the Köhlbrand opposite Altona was in special need of an improvement. The deep channel in that neighbourhood was very narrow and ran very close to the Altona river front. From there it proceeded in a sharp curve towards Waltershof, and then turned back to the northern side of the river. This condition greatly increased the danger of collisions at the very entrance to the harbour, i. e., at a spot where obstacles to shipping were particularly undesirable. The inconvenience was completely removed by the construction of a training wall *(Leitdamm)* which made the harbour at Altona completely independent of the current, and by that of stone groynes on the left bank as far as Finkenwärder (cf. the Historical Harbour Plans of 1885 and 1905).

It soon became apparent that a channel having a depth of 26 feet below high water was not sufficient for the requirements of ocean-going vessels whose tonnage was constantly increasing. Between Neumühlen and Lühersand, therefore, the channel was deepened to 33 feet (1903/1906), and this depth was maintained by providing a number of groynes on the right bank between Nienstedten and Wittenbergen. The width of the deep channel thus obtained was nowhere less than 660 feet. The carrying-out of all these important undertakings — of which only a very brief account can be given here — could scarcely keep pace with the development of shipping, which was particularly rapid in those years. Even before the latest of the great periods of regulation work came to an end, it became plain that it was merely the forerunner of another period during which measures still further modifying the condition of the river would have to be carried out, and that the method of doing piecemeal work employed until then would not lead to the desired results. What was required was a comprehensive scheme of regulating the navigation on the river, such a scheme being just as necessary as the general town-planning schemes to which municipalities have to resort at certain stages of their development. It would have to be based on uniform principles and to be applied to the part of the Elbe from the mouth of the Seeve down the river as far as the natural conditions demanded it.

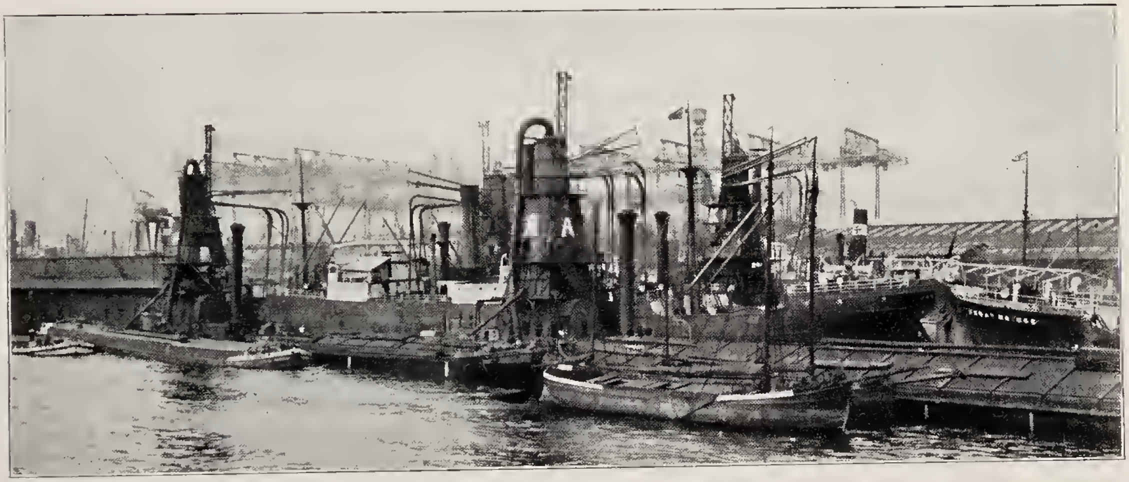


Fig. 79. Grain Elevators.

In thus exceeding the maximum widths and depths until then obtained it was no longer admissible to disregard the fact that in some places the banks were very irregular in their contours and that in others the width of the river was subject to very abrupt changes. Such irregularities, at least, could not be allowed to continue in existence in the Hamburg-Brunshausen reach. In that part the distances between opposite banks are greater than is necessary for the purposes of shipping — a state of things, which also makes it very difficult to protect the deep channel from deterioration. Below Finkenwärder the natural width of the river suddenly increases from 2,000 to 9,200 feet. After that it decreases again to 5,700, increases to 6,600 feet near Schulau, decreases to 5,200 feet at the mouth of the Lühe, increases to 6,000 feet further down the river, and decreases once more to 4,000 feet near Brunshausen. These unsatisfactory conditions gave rise to the formation of several subsidiary channels which adversely affected the usefulness of the main channel, and reduced the width of the latter in places to an extremely undesirable extent.

Such, in brief, were the conditions which Hamburg undertook — in addition to carrying out the measures affecting the Northern and Southern Elbe to which reference has been made elsewhere — to improve in accordance with the terms of the Köhlbrand Agreement of 1908. No provision was made for regulating the river below Brunshausen, because it was believed that dredging alone would suffice for the needs of that section, at least for some time to come.

The improved contours of the river have been adapted as far as possible to its natural course, except that existing curves have been straightened out. The width of the regulated area gradually increases from 1,200 feet near Altona to 3,600 feet above the mouth of the Schwinge near Brunshausen.

It is now intended to describe in outline the regulating works constructed for the purpose of carrying out the improvement aimed at. Those located above the new entrance to the Köhlbrand and provided in execution of the interstate agreement referred to have already been mentioned. On the left (or southern) bank of the river, the Waltershof shore is lined with wooden foundations rammed into the bottom with paved slopes behind them, the entrances to the harbour basins alone being without them. The long groynes still shewn on the Historical Harbour Plan of 1905 off Park and Pagensand, of course, have disappeared. At Finkenwärder the embankment is protected by parallel works consisting of fascine mattresses and tipped stone rubble. Between Finkenwärder and the Lühe the shore line recedes a long way from the channel. Consequently this is the part where the river bed is most liable to deterioration, and where the distance between the shore and the regulated area is greater than anywhere else. Such distance considerably exceeds one mile in certain places, so that the construction of groynes was out of the question there. Besides, it was necessary to leave intact the subsidiary channel close to the shore, because it is used for the local traffic to and from the small villages situated there. The only really suitable solution, therefore, was to build two training walls parallel to the two channels. This accordingly was done, and the two walls were also connected in three different places by dams meeting them at right angles. The spaces enclosed by the training walls and dams are filled up with dredged material. In this way several raised areas — with well protected banks, but only visible at low tide — are now forming between the main channel and the subsidiary one. The crest of the training walls does not emerge above the mean low water mark, because the only object aimed at was to fill up the huge water area between Finkenwärder and the Lühe in such a manner as to ensure that the flushing power of the water is sufficiently concentrated in the main channel at the turn of the tide, i. e., at the time when the velocity of the current reaches its minimum figure.

The most westerly of the artificial islands extends its tapering point to a spot between Kilometres 643 and 644 (these figures denoting the distances from the German-Czechoslovak frontier). Then follows the lower entrance to the subsidiary channel, which has a depth of 10 feet below low water and runs parallel to the northern shore of Hahnöfer Sand and the mouth of the Este as far as the Alte Süderelbe, of which it forms the continuation. The upper entrance is near Kilometre 635. About halfway between the two entrances, near Kilometre 640, there is a further connection between the two channels.

The section of the left river bank below the western entrance, i. e., on both sides of the mouth of the Lühe, is protected by groynes only, except that there are parallel works off the island of Lühersand. This is the limit of the regulated area on that side.

We now turn our attention to the right (or northern) bank where the steep diluvial ridge, as far as Schulau, extends to the water's edge. In continuation of the work completed in 1906, the part between Schulau and Juelssand was also protected by groynes and fascine-work moles, their outward extremities denoting the limit of the regulated area. Owing to the great width of the river in this section, some of the groynes are nearly one mile in length. Higher up the Elbe, between Wittenbergen and Schulau, the ridge lining the water's edge is so steep that the shore had to be specially protected. There was also the possibility of large masses of soil detaching themselves from the cliff and, by dropping into the river, contributing to its silting up. It was therefore necessary to create a protected foreshore between the groynes by means of parallel works.

Hamburg could not have undertaken so comprehensive a work of regulation unless she could be absolutely sure that Prussia would never dispute her right to deepen the channel for ocean-going shipping as much as she thought fit. This right, indeed, was conceded to her, as far as the Lower Elbe was concerned, by the 1908 agreement. At present the channel is being deepened to a maximum of 40 feet to 40 feet 4 ins. below M. H. W. and has nearly finished this work. The depth thus obtained completely satisfies the present requirements of shipping. The width of this deep channel ranges between 1,000 and 1,300 feet in most places, and is nowhere less than 660 feet.

The hope that the great work of regulation would practically do away with the necessity of frequently dredging the river, which was formerly indispensable and involved a great deal of expenditure, has been completely realised. Shipping, too, benefits from it inasmuch as vessels no longer find their course impeded by the numerous dredgers which used to restrict the freedom of their movements.

It has already been stated that, for the present at least, there is no immediate intention of extending the regulating work to the section between Brunshausen and Cuxhaven. That part of the river contains several large portions where it is scarcely necessary, because the natural depth of the channel is sufficient. There are, however, three areas where, owing to the peculiar and always changing conditions of the current, dredging cannot be resorted to without prohibitive expenditure, and where a different method will probably have to be employed, viz., the neighbourhood of the island of

Pagensand which is situated between Kilometres 660 and 665; the channel between the mouth of the Oste and the always shifting Ostebank near Kilometre 705, and the so-called "middle ground" *(Mittelgrund)* below Cuxhaven. Near the Ostebank the work of restoring the channel to and maintaining it at its former width has already commenced.

The energetic measures adopted in order to overcome the difficulties in the way of shipping on the Elbe shew how close is the connection between the Port of Hamburg and the Lower Elbe. The latter, in fact, must be regarded as an integral part of the former. Nearly a century of incessant hard work was required to ensure that the fairway of the river should possess a depth always sufficient for the changing needs of shipping at various periods.

★

Dredging.

The various kinds of river construction work carried out by Hamburg, e. g., the groynes, parallel works, and training walls, closely resemble the similar constructions elsewhere. The methods of dredging, on the other hand, employed by the port authorities, are to some extent peculiar to Hamburg, so that brief reference must be made to them in this context. The quantities of material dredged *per annum* — as may be inferred from the preceding description — have increased from year to year. Whereas the total was still very insignificant in the 'thirties and 'forties of the past century, the quantity of soil dredged from the Elbe and the harbour area in 1877 for the first time exceeded one million cubic metres. Between 1877 and 1897 the figure fluctuated between one and two millions. The third million was reached in 1903, the fifth in 1904, and the seventh in 1905. After a slight relapse it rose to over nine millions in 1910, and maintained this level during succeeding years. It was not until the completion of the last stage of regulating work, i. e., that of deepening the channel to 40 feet, that the dredging requirements diminished once more.

Additions to the existing dredging plant were made whenever this was necessary. So long as dredging was confined to the upper reaches of the river, bucket dredgers of the usual type were exclusively employed. Their numbers and sizes were augmented in the same proportion in which the requirements of shipping kept increasing. Generally speaking, the dredgers owned by the Government Board of Works were sufficient for these purposes. Contractors, however, had to be resorted to whenever it became necessary to carry out important dredgings covering extensive areas and taking place simultaneously. The largest of the bucket dredgers have a floating body 170 feet long and 33 feet wide. They have 44 buckets with a capacity of 23 cubic feet each. They fetch the material from a depth of 46 feet, are equipped with a steam engine indicating 370 H. P., and can dredge about 100,000 cubic feet during an eight hours' shift at the rate of twelve fillings and emptyings of the buckets per minute.

Bucket dredgers, however, were found insufficient for deepening the channel in the wide estuary of the Lower Elbe where the condition of the water is far more subject to changes than higher up the river. There they had to be replaced by pump or suction dredgers. Suction dredgers, as their name indicates, do not handle the soil by means of bucket chains, but use suction pipes having a diameter of 30 inches. Whereas the bucket dredgers — which are of rectangular shape — have to be tugged to and from their places of work and discharge their dredging material into barges for its further transportation, the suction dredgers resemble the hull of an ordinary ship, move under their own steam, and are provided with large holds amidships — equipped with bottom flaps — where the dredged material can be temporarily stored. They can work in all weathers, no matter how rough the sea may be. Their principal measurements are: 200 feet long, 36 feet wide, draught from 7 to 13 feet, dredging depth 50 feet, cubic capacity of hold 20,000 cubic feet, carrying capacity 1,100 tons. They are equipped with two pumping engines of 350 H. P. each and have speeds ranging from 7 to 10 knots. Two such suction dredgers are employed in the section below Krautsand, principally near the Ostebank and the Mittelgrund.

Inside the harbour basins smaller types of dredgers are used, and both bucket dredgers and grab dredgers may be seen there. The grabs are of powerful build, consist of there parts with a capacity up to 65 cubic feet, and are suspended from cranes.

A very considerable expenditure is incurred in connection with the work of removing the dredged material. For this purpose all dredging appliances, except suction dredgers and grab dredgers, require the assistance of numerous barges. These barges must be discharged of their contents as speedily and as economically as possible in order to be employed to their maximum capacity. The former method of using tipping barrows from which the sand was deposited on the shore was discontinued long ago because it was no longer adequate. It was replaced by the use of "hopper" barges which discharged their contents through bottom flaps. These barges, however, could only be employed so long as sufficient space was available outside the navigable channel, i. e., between the river bank and the sands, where the dredged material could be deposited. Such space was available to a limited extent only, at least in the upper section of the Lower Elbe. Wherever there was a risk of the soil discharged from the barges shifting back to the navigable channel, a new method had to be employed. Special appliances were therefore designed for the double purpose of emptying the dredging barges and of hauling the dredged material ashore where it was to be utilised for raising the level of the ground. We must distinguish in this connection between the so-called barge suction dredgers *(Schutensauger*, Fig. 80) and the barge dischargers *(Schutenentleerer*, Fig. 81). The latter kind espesially is typical of the dredging methods employed by the Hamburg port authorities. The barges used for these purposes differ from the ordinary type and are spoken of as suction barges *(Saugerschuten)*. Their holds, like those of the "hopper" barges, have a wide upper and a narrow lower part, but the bottom flaps are wanting. Suction barges are 120 feet long and 23 feet wide and have a carrying capacity of 9,000 cubic feet, whilst that of ordinary barges is only 1,800, and that of "hopper" barges 5,300 cubic feet.

The method of levelling up the ground by means of barge suction dischargers and dredgers has superseded that by means of crane bridges and cableways projecting far beyond the bank, which is only semi-automatic and therefore not sufficiently economical. Barge suction dredgers (Fig. 80) operate in a way resembling the work of ordinary pump or suction dredgers, except that they absorb the mixture of dredged material and water from the barges and, instead of retaining it in a hold of their own, convey it through long pipes to the area that is to be raised. The water afterwards drains off, but the sand remains where it was deposited. The length and the direction of the delivery pipes are altered from time to time in accordance with the progress of the work. The measurements of the barge suction dredgers are as follows: 1,300 feet long, 30 feet wide, 6 ft 6 ins draught. The capacity of the pumping engine is 900 H. P., the diameter of the suction piping 30 inches, and that of the delivery piping 24 inches. These engines enable the dredged material to be pushed forward to a distance of about 3,000 feet. Previous to starting the work for which the dredgers are used, the area to be raised must be surrounded by a dam to prevent the return flow of the mixture of sand and water. This dam, too, is made of dredged material, and the appliances used for the purpose are the barge dischargers (Fig. 81) above referred to. They empty the barges by means of bucket or grab dredgers. Their floating body consists of two supporting vessels connected by a portal-shaped iron structure below which the barge that is to be emptied of its contents is accommodated. From the iron structure the material is conveyed, by means of a 170-foot jib, to the spot where the projected dam is to be raised, and there deposited. Each apparatus can handle

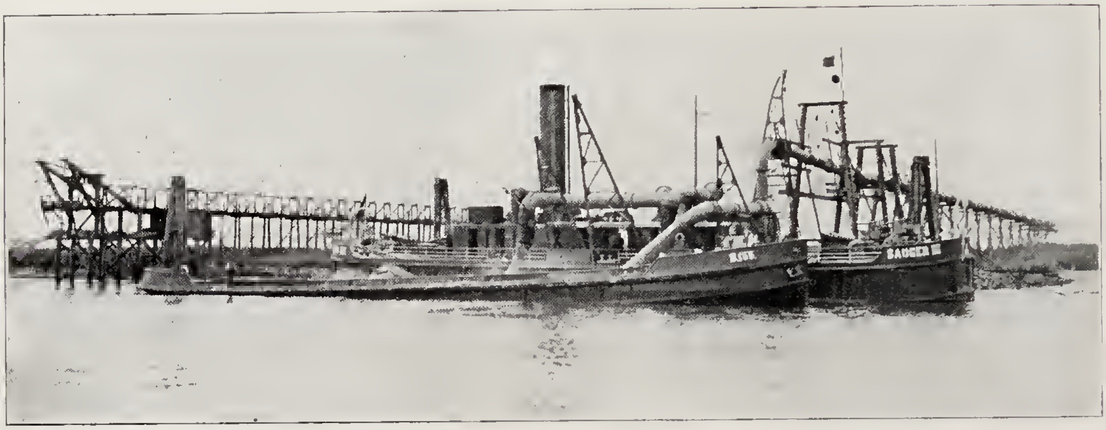


Fig. 80. A Barge Suction Dredger.

from 35,000 to 40,000 cubic feet during an eight-hour shift. The two supporting vessels are 100 feet long and 16 feet wide. Their draught is 4 feet and the distance between them 28 feet.

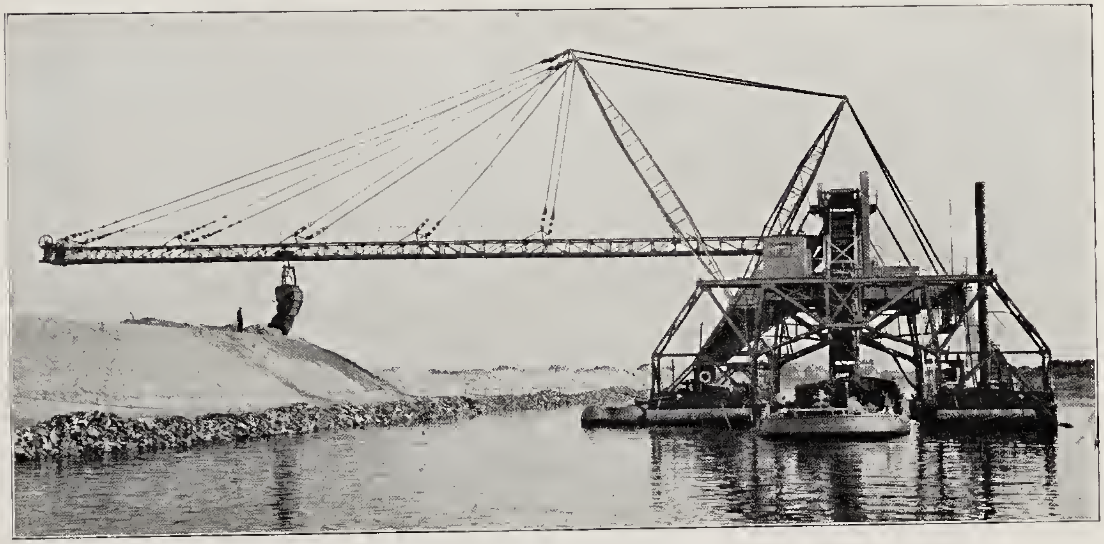


Fig. 81. A Barge Discharger.

On April 1st 1921, i. e., the date when the administration of all waterways in Germany — including, of course, the Lower Elbe — was transferred from the various state governments to the National Government, the latter also took over most of the dredging apparatus described above. Their number gives a rough indication of the extent of the dredging work going on in the harbour and on the Lower Elbe. The plant referred to, at the date just mentioned, consisted of:

18	dredgers,
205	barges,
12	tugs,
7	barge suction dredgers,
4	barge dischargers, and
40	other craft.

*

The System Marking the Navigable Channel.

The preceding descriptions have shewn that, although the river bed is of considerable width, the channel suitable for sea-going vessels and possessing the depth required by them is only some 1,000 feet wide, and that this channel is shaped like an irregular curve approaching sometimes the right, and sometimes the left bank of the river. It is necessary, therefore, to indicate the exact position of the fairway by a system of marks plainly visible at all times. In earlier days — when the sailing vessels did not risk the up-river trip to Hamburg at night-time, and when they had ample time to await daybreak in the safe shelter of a roadstead —it was sufficient to mark the channel for day navigation only. Such marking is as old as the shipping trade of Hamburg, and even the earliest charts of the Lower Elbe that have come down to us prove the existence of floating buoys anchored to the river bed, and of other marks posted ashore by which navigation across the sandbanks and shoals of the river — then still without its modern improvements — was guided. This primitive system, however, was gradually improved in accordance with the progress of shipping and the work of regulating the river. The principle of marking the limits of the navigable channel, for day navigation , by two rows of floating buoys, is still adhered to, but the wooden beacons ashore have mostly been removed. The southern limit of the channel, i. e., that on the starboard side of incoming vessels, is marked by red buoys provided with long spars — technically known as spar or mast buoys — and the northern limit, i. e., that on the port side of incoming vessels, by conical buoys painted black and called nun buoys. In addition, certain parts are specially marked by buoys of different pattern.

At a later period, when the presence of steamships became a regular feature on the Lower Elbe, it was also found necessary to mark the channel at night, because steamships cannot afford to lie idle for many hours waiting for the dawn of day. A few isolated spots of particular importance had always been marked by light signals. Such were the beacon fires on Neuwerk and Heligoland and the beacon light at Cuxhaven — all of which were erected by Hamburg. The origin of the solid watch tower on the island of Neuwerk dates back to 1372/1380, although the present beacon fire was not installed until 1814. Gradually, a fairly large number of isolated navigating lights were provided on the Lower Elbe as well, but a uniform system of marking the course of the river by night cannot be said to have existed prior to the second half of the past century.

The present system is shewn in the accompanying chart of the Lower Elbe and is characterised by the provision of two principal kinds of lights, viz., range lights and leading lights, whose ranges are limited by the so-called transverse lights. Every range light installation consists of an upper and a lower light separated by a certain distance. The imaginary line that joins them coincides, if produced, with the middle line of the fairway within a certain section of the river. Ships of great draught can thus ascertain the proper course they have to follow by bringing the two lights into line. At the same time smaller vessels are enabled to keep to that side of the channel which is intended for their use. The upper lights shew a fixed, the lower lights an intermittent white light. In this manner every reach of the river is clearly marked by a range line of its own. Since, however, the double lights entail a very expensive upkeep, they have been dispensed with wherever the channel is wide enough for ships to do without them, and there they are replaced by single lights, called leading lights. These latter indicate the limits of the fairway by a leading sector, but do not indicate the middle line of the deep water channel. Whenever a vessel approaches the limit of the channel too closely, she is warned by a change in the fixed light. She is then within the range of the so-called warning sector where the light shewn differs according as she has come too near to one or to the other side of the navigable channel. Special devices are required where ships begin to gradually alter their course. Such alteration, of course, must be effected before the vessel reaches the points where the range lines, or the guiding sectors, as the case may be, intersect, and its extent must depend on the size of the angle contained by the direction indicating the original course and that indicating the new one. The object aimed at is served by the transverse lights which are intended to shew how far the range lights or guilding sectors respectively may be followed by the ships. The ships' course has to be altered where the white colour of these transverse lights changes into red or green.

All the lights described so far are on shore where light-houses of various designs and of various heights are built for their accommodation (Fig. 82). In addition, certain specially important parts of the fairway are marked by floating gas buoys, or (in the wide estuary outside Cuxhaven) by light ships. Altogether, there are more than fifty lights of various kinds indicating the course of navigation at night.

On her way down the river, the course of a vessel is at first guided by several harbour lights marking the entrances to the various basins or some other prominent parts. She does not come within reach of the range light system until she has passed Blankenese. The first range lights are those of Wittenbergen (lower light) and Tinsdahl (upper light). From the guiding line (U)[1] indicated by this pair of lights she changes over, by a slight deviation from her course, to the second line (U) marked by the Lühe-Grünendeich light-houses on the left bank of the river. The Billerbeck light-house, owing to an alteration of the channel, is no longer part of the range light system. When off the mouth of the Lühe, the ship changes her course again and takes her bearings from the Somflether Wisch (upper) and Mielstack (lower) range lights (D). Near Lühersand a slight turn to port enables her to follow the fourth range line (U) laid down by the Bützflether Sand (lower) and Bützfleth (upper) range lights. The four last-named light-houses are situated on the left bank of the river. Brunshausen, at the mouth of the river Schwinge — a spot conspicuously visible for its self-registering tide gauge with its varying number of horizontal indicators — marks the upper extremity of the big curve in the course of the river, the concave side of which faces south. Consequently the angle at which the two guiding lines meeting there intersect one another is comparatively large. The Bassenfleth (upper) and Stader Sand (lower) range lights (D) indicate the course of the vessel south of Pagensand and slightly beyond it until she comes within the range of the line (D) indicated by the two light-houses situated on this small island. A further small deviation from her course brings her in line with the two Krautsand range lights (U) — a line, however, which she abandons shortly afterwards in order to take her bearings from the Hollerwettern (lower) and Brockdorf (upper) pair of range lights. The reach marked by these two light-houses is the longest straight course the vessel has followed so far. No alteration takes place until she has arrived off the

---

[1] The letter D denotes a guiding line pointing down-river. The letter U denotes a guiding line pointing up-river.

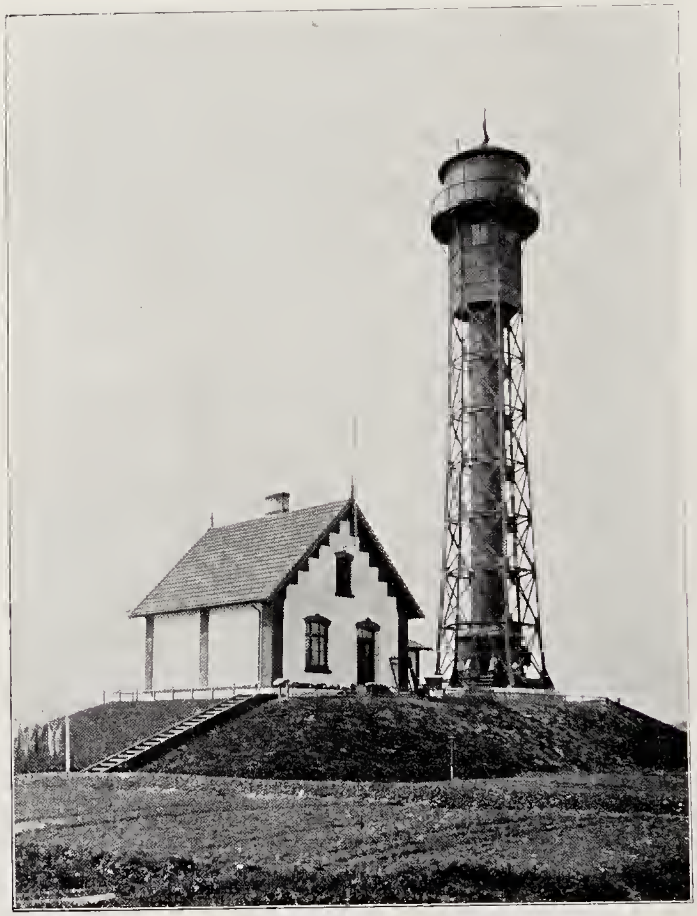


Fig. 82. A Lighthouse on the Lower Elbe.

mouth of the Stör, after which her course is for a long time shewn by the two guiding sectors of the Scheelenkuhlen light-house, one of which points up-river, whilst the other points down-river. It is not until the ship has reached the entrance to the Kiel Canal (Kaiser-Wilhelm-Kanal) that she is guided once more by a pair of range lights, viz., those placed at Sösmenhusen (lower) and Brunsbüttelkoog (upper), both of which are situated on the right bank of the river. After that, there are three more pairs of range lights intended to assist the vessel during the last part of her way down the river, viz., the Hullen lights near the Oste-Bank; the Altenbruch (lower) and Groden (upper) lights, and the Groden (upper) and Neufeld (lower) lights (D). In changing over from the Altenbruch-Groden to the Groden-Neufeld range line, the ship avails herself of the channel sectors shewn by the Neufeld, Cuxhaven, and Altenbruch guiding lights. The further course of the ship is marked by the Elbe 4, Elbe 3, Elbe 2, and Elbe 1 light-ships, after which she reaches the open sea.

In order not to encumber the above description too much, no mention has been made of the transverse lights.

The principal sources of illumination, with the exception of the electric light installations of the Cuxhaven light-house, of light-ships Nos. 1, 2, and 3, and of the Bassenfleth range light — which has recently been fitted with liquid-gas incandescent light — are paraffin, incandescent, and wick light. The intensity of the light is enhanced, in most cases, by Fresnel's belt lenses, whereas the characters of the sectors are distinguished by occultations lasting varying periods and produced by Otter's diaphragms. The latter consist of narrow, upright, and revolving sheets of aluminium made to rotate by clockwork or engine power at measured intervals. Coloured light is obtained by means of stained glas, but as its luminosity is but slight, it is only used for transverse lights.

Most of the lights on shore are looked after by attendants living on the spot. The gas buoys, however, and some of the light beacons, are charged with blue gas. They emit their light during the day and night time and require no attendance.

The system of lights described above enables the pilots aquainted with it to guide the ships up or down the Lower Elbe at night time as quickly and as securely as during the day.

★

The extent to which Hamburg has improved the higway of the Lower Elbe out of her own funds is most clearly indicated by the money she has spent on this work. Her expenditure on this account amounted to 160,000,000 marks up to April 1st 1921, the date when the administration of the waterways was taken over by the National Government.

SECTION SEVEN.

The Port of Cuxhaven.

The town of Cuxhaven is situated 64 miles below Hamburg on the left (or southern) shore of the Elbe estuary which has a width of about 11 miles. It is the capital of the "bailiwick" of Ritzebüttel, an outlying portion of the Hamburg state area bordered by the Prussian province of Hanover and the North Sea. Its harbour facilities extend to a length of just under a mile along the riverside east and north of the town.

(Cf. the inset map of Cuxhaven on the accompanying Map of the Port of Hamburg. Scale: 1 to 12,500, i. e., twice as large as that of the principal map.)

The tasks that have to be looked after by the Port of Cuxhaven are altogether different from those that fall to the share of the Port of Hamburg, which latter, indeed, Cuxhaven is intended to supplement. It is a port of refuge used by vessels in distress and by such as are unable to put to sea owing to ice conditions. It is also a quarantine station, a pilot and marine signalling station, and the headquarters of the service for marking the fairway of the Elbe, but above all it is one of the biggest and most up-to-date fishing ports and the point where the fast steamers engaged in the Hamburg-New York traffic embark and disembark their passengers. On the other hand, it is practically unused for the transhipment of sea-borne cargo — a function for which, as has been explained earlier in this book, it is not suitable. The few facilities of this kind that have actually been provided are only used for local needs and occasionally for certain special purposes.

The geographical conditions materially affecting the construction of harbour works at Cuxhaven completely differ from those that obtain in Hamburg. The forces of nature that have to be taken into account are far stronger there than they are higher up the river. It is quite true that the ground-swell, at least during the prevailing south-western winds, is deviated from the Cuxhaven shore by the projecting headland that terminates at Kugelbaake, but for this very reason the concave shore is particularly exposed to the inroads of the tidal currents. For centuries, indeed, a fierce struggle for the possession of that part of the land which lies below the level of the highest tides has been going on between man and Nature, and complicated dykes and shore-protecting works had to be constructed. The margin between normal high and normal low water is 9 feet 6 ins, which is in excess of the corresponding figure for Hamburg, and the difference between the highest and lowest level of water actually recorded is as much as 27 feet 6 ins. The layer of silt deposited in the harbour basins sometimes attains to a thickness of 10 feet *per annum*, thus necessitating regular dredging operations. The water contains the same percentage of salt (3 %) as the North Sea water generally, so that special precautions have to be taken where iron and reinforced concrete is employed for under-water constructions, and is infested with the teredo or ship-worm which attacks submerged wood. The layer of sand suitable for foundation work is not encountered until a very great depth is reached, and in most cases the piles that have to be driven into it are required to have a length of 65 feet.

It is owing to these natural difficulties that the Port of Cuxhaven remained practically unused, except as a port of distress, until a comparatively recent period. The first dykes, however, were built at a very early age, probably during the eleventh century, and certainly long before the acquisition of the "bailiwick" of Ritzebüttel by Hamburg (1394). The various dyking schemes, indeed, proved so successful that it was found possible to constantly reclaim new ground at the expense of the river. The so-called Neuer Deich, built in 1618, actually occupied a site much further seaward than the present shore, but in the end the forces of nature proved too strong, and some of the area reclaimed from the river had to be abandoned, so that from the early part of the eighteenth century onward the boundary between land and water has occupied once more the line existing prior to 1618. In time it was realised dykes alone were not sufficient, and the parts particularly exposed to the dangers of the sea and the river were provided with protective works. The first of these were the Alte Liebe works (built from 1729 to 1732) and the strong dam near Kugelbaake (built about the same time). This provision was augmented by the building of Osterhörner Stack (1745/1755) on a site now approximately occupied by Osterhöft, the pierhead flanking the entrance to Amerikahafen. In 1793 Reinhold Woltmann — with whose name we are already familiar from a previous section of this book — commenced his activities by the construction of Grodener Stack and Glameier Stack, which are situated above the area now used for harbour purposes. Additional shore-protection works were subsequently erected between those just named in accordance with plans designed by Woltmann. The outcome was that a suitable shore line — a necessary preliminary to any regular harbour works — was gradually provided.

At that time the harbour merely consisted of the lower end of the shallow Ritzebütteler Schleusenpriel whose junction with the Elbe was protected by the Alte Liebe work and later on by a parallel work built in 1857, the so-called Schutzhöft, situated in the rear of the present Seebäderbrücke. This harbour, the Alter Hafen, was so shallow that it was practically without any water at every low tide. Woltmann, in order to provide it with a greater depth, constructed a flush basin with an inlet sluice in 1792, thus increasing the depth of the fairway by about 3 feet. No real improvement, however, was made until forty years later when steam dredging was introduced, and in 1868 the Alter Hafen was given its present shape, i. e., that of a rectangular basin having a depth of 13 feet below low water. Its banks were protected by solid wooden plank work. The work of modernising the Port of Cuxhaven, therefore, was not started until after the completion ot the first quay in the Port of Hamburg.

The further development of the Port of Cuxhaven, like that of the Port of Hamburg, was delayed for some time by dock harbour projects designed by British engineers. Two such schemes for the construction of a seaport along very ambitious lines were prepared, and on one of them work was actually started. However, the impracticabiliy of the project soon became evident, and after some excavation work had been done, no further progress was made. The only trace left of these schemes is the so-called Hafenloch (Fig. 83a).

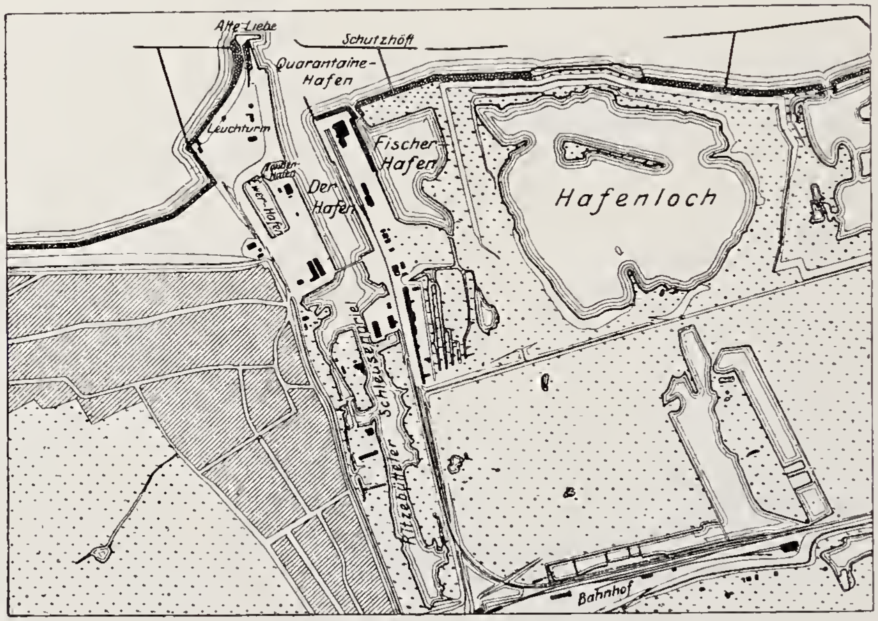


Fig. 83a. The Port of Cuxhaven in 1890.

In 1883 the Hamburg Board of Hydraulic Engineering *(Wasserbaudirektion)* took up work on an entirely different project which provided for the improvement of the old Fischerhafen and of the Neuer Hafen (the latter being later on converted into the present Amerikahafen). The Fischerhafen was modernised in 1890/92, but its present much enlarged form dates to a later period. Its further development will be traced below.

A task of greater magnitude was the construction of Neuer Hafen and its equipment with landing facilities for the big passenger steamers that were to make Cuxhaven a port of call. In the 'eighties of the past century the Hamburg-Amerika Linie began to feel the inconveniences resulting from the arrangements made in connection with their fast passenger services, and they decided that the steamers engaged in them should no longer disembark their passengers in Hamburg, but at Cuxhaven whence they would be conveyed to Hamburg by special trains. Corresponding arrangements were to be made for the outward-bound steamers. Consequently, the more westerly of the two existing pierheads (Fig. 83b) — now forming part of Landungshöft — was converted into a landing stage. In view of the measurements of the biggest steamers then in use it was thought that a water frontage of 400 feet would be sufficient. The pierhead had to be sufficiently extended to make it adjacent to water possessing a depth of 38 feet at low-water mark. A construction projecting so far into the river would inevitably give rise to eddies in the fairway of the big liners if nothing were done to prevent it. In 1886, therefore, a parallel work 1,650 feet long was built above the eastern pierhead and extended as far as Osterhörner Stack, and a similar work, but only 650 feet long, below Alte Liebe. Caissons were used for the construction of the two pierheads, the measurements of the largest being 400 × 50 × 30 feet. The entrance was 330 feet wide. The shape of the basin — which was intended to accommodate sea-going vessels — is shown in Fig. 83b. It was provided with a depth of 30 feet at low-water mark, and covered an area of 22 acres. Its banks were lined with concrete quay walls supported by wooden foundation grills, the front row of piles being embedded in concrete as a protection against the teredo (shipworm). This basin was completed in 1892/96. On Lentzquai, its west bank, a railroad station for the passenger traffic and transhipment facilities for cargo were provided, the latter being intended to be used by vessels which, on account of

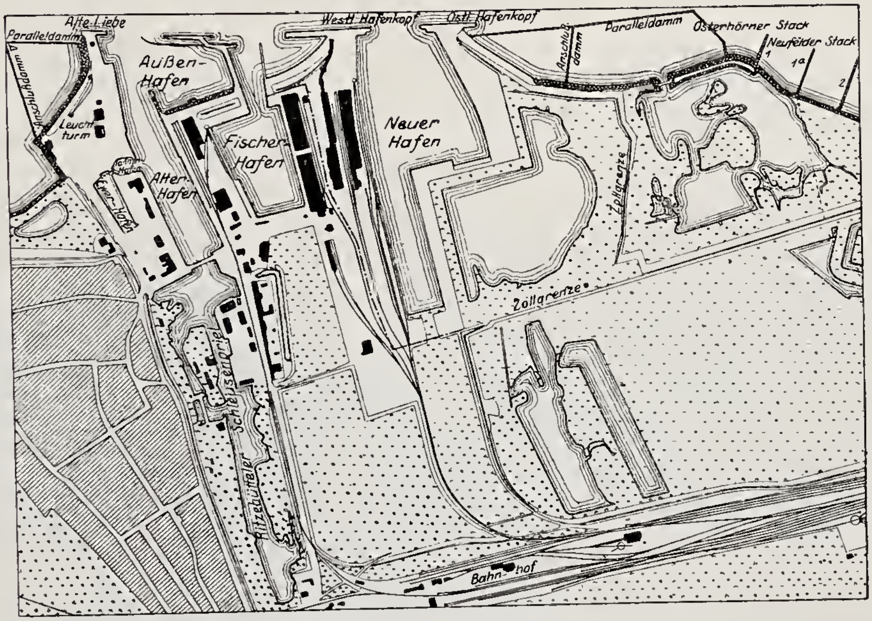


Fig. 83b. The Port of Cuxhaven in 1908.

the condition of the fairway as then existing, could not proceed to Hamburg with their cargoes. Comparatively little use, however, was made of these facilities, because the work of regulating the river was making rapid progress in those days.

By the time the basin was completed (1896), the measurements of steamers had very considerably increased. About 1900 the biggest of them were about 660 feet long. The frontage of the pierhead, therefore, was extended by 200 feet of wooden construction, thus raising its total length to 600 feet. Shortly after 1910, however, this increased length again proved absolutely insufficient. The biggest liners then engaged in the services of the Hamburg-Amerika Linie were 1,000 feet long, and in order to ensure their proper mooring, a frontage of 1,300 feet was required. It was found that a considerable extension of the entire landing facilities along generous lines was the only practical solution, and that such extension would have to result in the provision of a closed-in harbour basin to accommodate the company's giant liners which at that time had to be berthed in the open roadstead off Altenbruch. Accordingly, the two pierheads of Neuer Hafen were connected with one another in such a way that the present Landungshöft was formed (Fig. 84). It is 1,300 feet long and 70 feet wide. Thus, the entrance to Neuer Hafen disappeared altogether. In addition, its eastern quay wall was blown up with dynamite, and the basin was enlarged to such an extent that the present Amerikahafen was formed. Between Landungshöft and the newly constructed Osterhöft a passage 1,000 feet wide was left open, so that even the biggest vessels could enter the basin in a direction forming an acute angle with the shore line. The water area of Amerikahafen covers 100 acres, which means that it is approximately equal to that covered by Waltershofer Hafen. Its ultimate

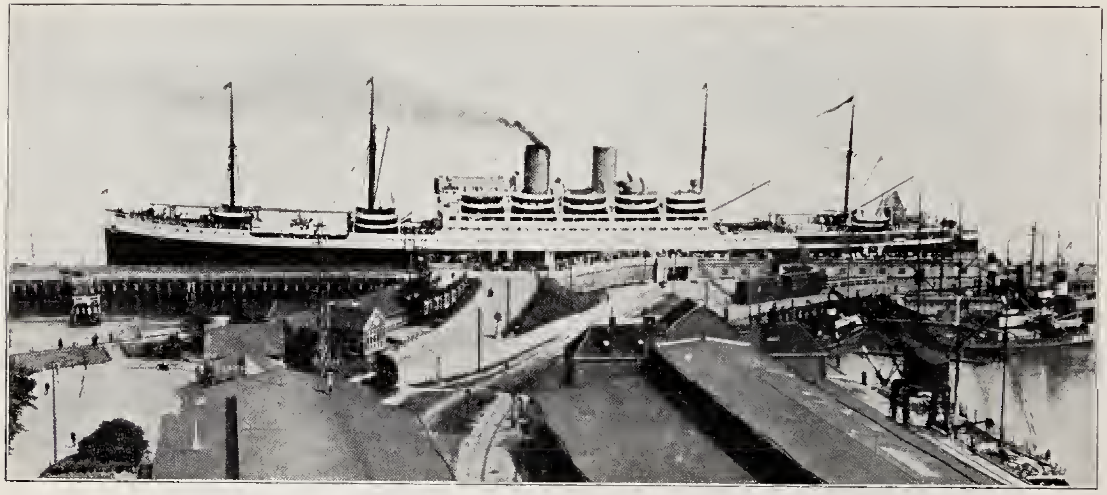


Fig. 84. Landungshöft, Cuxhaven.

depth is to be 40 feet below low-water mark. Landungshöft has direct rail connection with the new harbour railroad station, and is also connected with the waiting rooms of the latter, and with the custom-house clearance stations, etc., by a covered passage, thus enabling the transfer of passengers and their luggage from the ocean-going steamer to the train and *vice versa* without loss of time and without inconvenience. During the height of the season the railroad station is capable of handling a special train every fifteen minutes. All this extension work was carried out in 1912/14.

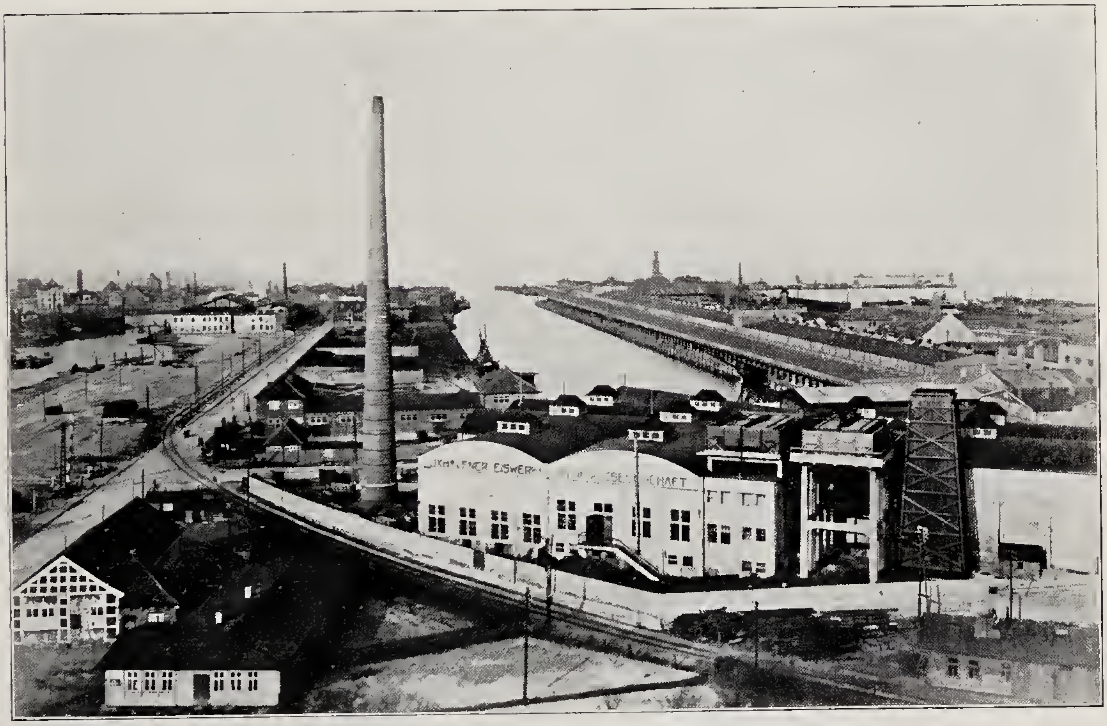


Fig. 85. Fischereihafen, Cuxhaven.

At present the fishery harbour *(Fischereihafen)*, together with the fish market adjoining it, is the busiest and most important part of the whole port. Seeing how favourably Cuxhaven is situated in relation to the fishing grounds of the North Sea, it is but natural that it has been a fishermen's port for a very long time past. It was, however, not until comparatively recently that the authorities realised the advantages of its position as a centre for the distribution and sale of fish on a large scale.

A small fishermen's harbour of primitive design was already in existence previous to 1890, as is shewn in Fig. 83a. It has already been said that this harbour basin was modernised during 1890/92. At that time it was given the shape shewn in the same illustration, its depth was increased to 10 feet below

low-water mark, and its banks were lined with plank work up to 3 feet 9 ins above mean high-water mark. Even in this improved shape the basin was merely intended to be a port of refuge for fishing craft, which at that time were exclusively sailing vessels. Subsequently, however, steam trawlers were increasingly used for fishing purposes, and in 1906, when the Cuxhavener Hochseefischerei-A.-G. was established in connection with this development, the provision of market halls for the sale of fish had to be taken in hand. The work was started in 1907 on behalf of the Hamburg state government. Fischhalle I and II were built on the eastern shore of the basin, the height of the quay walls was raised by 3 feet, the depth of the basin was increased by 4 feet 6 ins, and wooden loading platforms were provided in front of the embankments, whose stability was sufficient only for a depth of 10 feet below low-water mark. They were made wide enough to extend beyond the sloping part of the bottom of the harbour basin resulting from the increase in its depth. A railroad station for the transportation of the fish consignments was built close to the market halls. These various facilities were completed in 1908. An extension, however, by the addition of a third market hall became necessary as early as 1910. Moreover, the tapering shape of the entrance to the basin was found an inconvenience. Simultaneously with the work of widening it, the two banks of the basin were provided with quay walls made of reinforced concrete, Fischhalle III was increased in length, Fischhalle I and II were widened, and the railroad station referred to was enlarged. The projected extension of the whole basin to three times its existing length had to be postponed owing to the war, but was carried out between 1918 and 1922. Since then the Cuxhaven fish-trade has increased still further in extent, the outward expression of this development being the establishment of a second large concern, viz., the Deutsche Seefischerei A.-G. (1918).

The length of the basin in its pressent condition (Fig. 85) is 3,200 feet. The modern portion has a width of 250 feet, whereas that of the older section is 500 feet. Where the two parts join, the basin is only 160 feet wide. It is intended to provide a suspension ferry for road traffic at this spot, but the work of carrying out this project has been postponed for the present. The east bank is used by the steam trawlers for discharging their cargoes of fish, and the west bank is reserved for equipment and bunkering purposes. Altogether there are now six market halls for fish in addition to the corresponding auction halls. Each of them is 500 feet long, except Hall No. III, the length of which is only 300 feet. Each hall consists of a lower storey containing packing and refrigerating rooms, and an upper storey used for office and storage purposes. The halls have a width of 65 feet. Lengthwise they are divided into sections ranging from 33 to 130 feet in extent. The auction halls (Fig. 86) immediately adjoin the market halls on the quay side and are 55 feet wide each. There is one auction hall to every two market halls. The banks of the basin, both of the old and new sections, are lined with quay walls made of reinforced concrete which permit the basin to be used to a depth of 20 feet below-water mark. The existing facilities enable about twenty steam trawlers to discharge simultaneously, so that, on the assumption that each trawler gets its turn every seventh day, they are sufficient for the needs of a fishing fleet of 140 units. The present fishing fleet consists of 106 vessels only, but the possibility of providing additional accommodation for fishing craft in the Neuenfeld district south of Amerikahafen has been taken into consideration nevertheless. The district just referred to is already being made use of by the various fish-preserving industries now that all the sites that were available near Fischereihafen have been utilised for this purpose. There are numerous works for curing, pickling, and otherwise preserving the fish as soon as they are discharged from the trawlers that brought them, and there are others where codfish is dry-salted, and where fish oil and fish meal is manufactured. Their number is added to by several factories where tins and packing cases are made, and by ice-making plants. The work is carried out in strict accordance with a definite schedule, so that all possible delays are eliminated, and the pace is set by the times of departure of the fish trains. The railroad station from which the latter are despatched has now been considerably enlarged. The discharge of the incoming trawlers is effected during the cool night hours, and is immediately followed up in the early morning hours by the fish auctions and by the business of packing and otherwise treating the consignments of fish preparatory to their being transported. The fish-market business is operated by a company

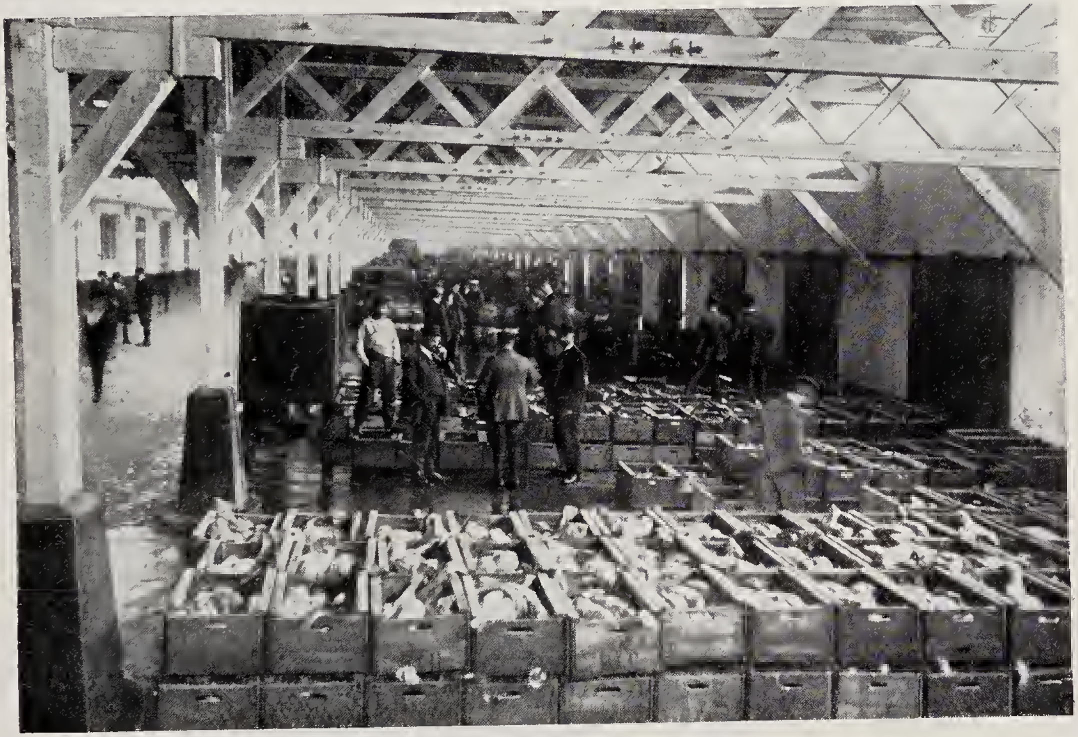


Fig. 86. Interior View of a Cuxhaven Fish Auction Hall.

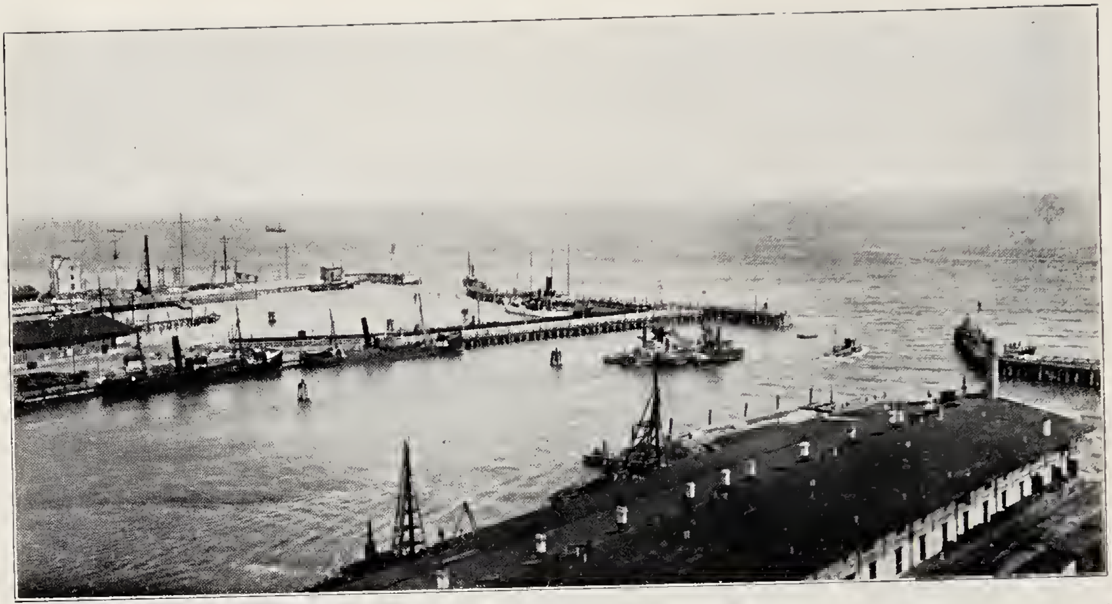


Fig. 87 The Entrances to the Fischereihafen and the Alter Hafen, Seebäderbrücke, and "Alte Liebe" at Cuxhaven.

controlled by the state, all the shares of which are owned by the latter. The great importance of Cuxhaven as a centre of the fishing trade is illustrated, among others, by the fact that the supply of fish offered there for sale in 1926 amounted to 104 million (German) pounds, as compared with 32 million pounds offered at the Hamburg fish market.

The third of the Cuxhaven harbour basins, viz., Alter Hafen (Fig. 87), serves to accommodate vessels generally. It is likewise lined with reinforced-concrete quay walls, and has an average depth of 13 feet below low-water mark. Its southern part is separated from Schleusenpriel by a swivel bridge. The former harbour railroad station, now only used in connection with the passenger steamer services to the seaside resorts, adjoins the basin on its eastern side. The steamers just referred to embark and disembark their passengers at Alte Liebe and Seebäderbrücke, the two wooden landing stages flanking the entrance to Alter Hafen on either side.

The Central Railroad Station *(Hauptbahnhof)* occupies a site close to the harbour and extends in a direction from east to west. It is the terminus of the lines from Hamburg-Altona and Geestemünde, so that the four biggest German fishing ports are directly connected by train and those of them specially provided with facilities for supplying the hinterland, viz., Cuxhaven and Geestemünde, can transport their products jointly. The three harbour railroad stations, the fish market halls, and the industrial concerns are all connected with the *Hauptbahnhof*.

The larger part of the Port of Cuxhaven is constituted as a Free Port, but the fish market halls, the industrial district, and the inner section of Fischereihafen are excluded from it.

SECTION EIGHT.

Some Statistical Data.

This section is intended to furnish the reader with some statistical information on the volume of the Port of Hamburg traffic, on the size of the port, and on its technical installations. Some of this information has already been given elsewhere in this book.

A. The Harbour Traffic

I. The Movement of Ships.

(a) The Development of traffic with the Port of Hamburg between 1826 and 1926 in respect of incoming vessels.

Year	Sea-going Vessels (excluding deep-sea fishing vessels)		Rivercraft	
	No.	Net Register Tonnage	No.	Cargo Capacity expressed in tons of 1,000 kgs each
1826	2,369	199,000	No statistics available	
1836	2,497	248,000		
1846	3,779	419,000		
1856	5,201	880,000		
1866	5,185	1,328,000		
1876	4,937	2,178,000	4,534	595,000
1886	6,384	3,729,000	9,257	1,738,000
1896	9,118	6,306,000	14,162	3,350,000
1906	12,982	10,824,000	20,387	7,586,000
1913	15,073	14,185,000	23,279	9,538,000
1919	2,234	1,544,000	7,408	2,776,000
1920	4,808	4,486,000	7,852	2,881,000
1921	8,401	9,421,000	10,829	4,488,000
1922	10,787	12,980,000	10,126	4,321,000
1923	13,192	15,344,000	9,657	4,277,000
1924	12,527	15,540,000	11,698	5,053,000
1925	13,240	16,635,000	14,090	6,020,000
1926	14,788	17,423,000	15,798	6,928,000

The above figures, inasmuch as they deal with rivercraft, refer to arrivals from the Upper Elbe only. They are, therefore, exclusive of the traffic between

Hamburg and the Lower Elbe ports. Statistical information concerning this latter traffic is only available for the years from 1913 onward. The following table shews the figures.

Year	No.	Cargo Capacity
1913	15,178	1,222,000 tons
1919	7,644	495,000 ,,
1920	6,922	444,000 ,,
1921	7,595	475,000 ,,
1922	7,137	451,000 ,,
1923	5,162	363,000 ,,
1924	6,988	447,000 ,,
1925	7,640	508,000 ,,
1926	9,247	680,000 ,,

(b) Nationality of the ships arriving in 1926.

1.	Germany	6,714,000 net reg. tons	= 38.5 %
2.	United Kingdom	4,633,000 ,, ,, ,,	= 26.6 %
3.	Netherlands	1,927,000 ,, ,, ,,	= 11.1 %
4.	France	684,000 ,, ,, ,,	= 3.9 %
5.	Norway	679,000 ,, ,, ,,	= 3.9 %
6.	United States of America	629,000 ,, ,, ,,	= 3.6 %
7.	Denmark	458,000 ,, ,, ,,	= 2.6 %
8'	Japan	385,000 ,, ,, ,,	= 2.2 %
9.	Sweden	256,000 ,, ,, ,,	= 1.5 %
10.	Danzig	216,000 ,, ,, ,,	= 1.2 %
11.	Italy	154,000 ,, ,, ,,	= 0.9 %
12.	Spain	61,000 ,, ,, ,,	= 0.4 %
13.	Belgium	54,000 ,, ,, ,,	= 0.3 %
14.	Portugal	34,000 ,, ,, ,,	= 0.2 %
15.	Miscellaneous	539,000 ,, ,, ,,	= 3.1 %

(c) Countries of origin and countries of destination. See page 15 to 16.

(d) Sources of up-river traffic in 1926.

	Vessels	Carrying Capacity in tons
1. Elbe ports	9,049 = 57.3 %	4,399,000 = 63.5 %
2. Havel and Spree ports	3,028 = 19.2 %	1,170,000 = 16.9 %
3. Saale and Unstrut ports	433 = 2.7 %	146,000 = 2.1 %
4. Other tributaries of the Elbe	1,791 = 11.3 %	612,000 = 8.8 %
5. Oder ports and ports further east	1,497 = 9.5 %	601,000 = 8.7 %

(e) Destination of up-river traffic in 1926.

1. Elbe ports	8,431 = 55.6 %	4,086,000 = 62.0 %
2. Havel and Spree ports	3,713 = 24, 5 %	1,438,000 = 21.8 %
3. Saale and Unstrut ports	448 = 2.9 %	149,000 = 2.3 %
4. Other tributaries of the Elbe	1,333 = 8.8 %	406,000 = 6.2 %
5. Oder ports and ports further east	1,250 = 8.2 %	506,000 = 7.7 %

(f) Share of the quays in the despatch of incoming ocean-going ships on the basis of the net register tonnage of the latter.

Year	State Quays	Leased Quays	Totals
1913	33 %	24 %	57 %
1922	34 %	31 %	65 %
1923	32 %	25 %	57 %
1924	31 %	30 %	61 %
1925	34 %	32 %	66 %
1926	32 %	32 %	64 %

II. Goods Traffic.

(a) Development of goods traffic from 1846 to 1926.

Incoming Traffic.

Year	By sea-going vessels	By rivercraft	By rail
1846	520,000 tons	407,000 tons	
1856	1,118,000 ,,	492,000 tons	158,000 tons
1866	1,149,000 ,,	845,000 ,,	270,000 ,,
1876	2,327,000 ,,	929,000 ,,	864,000 ,,
1886	3,410,000 ,,	2,009,000 ,,	1,443,000 ,,
1896	7,104,000 ,,	2,023,000 ,,	1,934,000 ,,
1906	12,751,000 ,,	3,568,000 ,,	3,288,000 ,,
1913	16,548,000 ,,	5,382,000 ,,	5,245,000 ,,
1919	1,837,000 ,,	1,261,000 ,,	3,668,000 ,,
1920	3,907,000 ,,	1,565,000 ,,	4,854,000 ,,
1921	7,502,000 ,,	1,383,000 ,,	No statistics available
1922	10,972,000 ,,	2,438,000 ,,	
1923	14,158,000 ,,	2,574,000 ,,	
1924	12,984,000 ,,	3,089,000 ,,	3,390,000 tons
1925	12,429,000 ,,	3,434,000 ,,	4,004,000 ,,
1926	11,041,000 ,,	4,966,000 ,,	8,495,000 ,,

Outgoing Traffic.

Year	By sea-going vessels	By rivercraft	By rail
1846	215,000 tons	375,000 tons	
1856	460,000 ,,	436,000 tons	173,000 tons
1866	No statistics available		
1876	726,000 tons	393,000 tons	635,000 tons
1886	1,835,000 ,,	1,036,000 ,,	681,000 ,,
1896	3,241,000 ,,	2,908,000 ,,	905,000 ,,
1906	6,193,000 ,,	5,008,000 ,,	1,764,000 ,,
1913	8,910,000 ,,	7,248,000 ,,	2,615,000 ,,
1919	506,000 ,,	1,638,000 ,,	1,316,000 ,,
1920	1,891,000 ,,	1,900,000 ,,	2,010,000 ,,
1921	3,599,000 ,,	2,378,000 ,,	No statistics available
1922	5,615,000 ,,	2,418,000 ,,	
1923	6,774,000 ,,	2,223,000 ,,	
1924	6,545,000 ,,	3,028,000 ,,	4,102,000 tons
1925	6,962,000 ,,	3,305,000 ,,	3,319,000 ,,
1926	10,870,000 ,,	3,343,000 ,,	2,774,000 ,,

(b) Details concerning goods traffic in 1925 1926.

1. Sea-borne Imports (1925).[1]

Classified according to countries of origin. Total figure: 12,429,262 tons. Particulars concerning countries:

1.	United Kingdom	2,489,411 tons	= 20.0 %
2.	Germany	704,673 ,,	= 5.7 %
3.	Russia	399,731 ,,	= 3.2 %
4.	Sweden	288,770 ,,	= 2.3 %
5.	Spain	253,776 ,,	= 2.0 %
6.	Italy	227,996 ,,	= 1.8 %
7.	Denmark	153,770 ,,	= 1.2 %
8.	Roumania	142,497 ,,	= 1.1 %
9.	Norway	138,668 ,,	= 1.1 %
10.	Finland	83,379 ,,	= 0.7 %
11.	Greece	81,856 ,,	= 0.7 %
12.	Netherlands	80,956 ,,	= 0.7 %
13.	France	48,849 ,,	= 0.4 %
14.	Esthonia, Latvia, Lithuania	44,936 ,,	= 0.4 %

---

[1] In some tables the 1925 figures have been given instead of those for 1926 because the latter were abnormally swollen owing to the British coal stoppage.

15.	Belgium	33,110 tons	= 0.3 %	
16.	Portugal	31,091 ,,	= 0.3 %	
17.	Bulgaria	26,014 ,,	= 0.2 %	
18.	Danzig	14,289 ,,	= 0.1 %	
19.	Poland	13,124 ,,	= 0.1 %	
20.	Other European countries	50,409 ,,	= 0.4 %	
	Total for Europe			5,307,305 tons = 42.7 %
21.	United States	2,062,382 tons	= 16.6 %	
22.	Canada and Newfoundland	570,009 ,,	= 4.6 %	
23.	Mexico	147,996 ,,	= 1.2 %	
24.	Central America and West Indies	47,567 ,,	= 0.4 %	
	Total for North and Central America			2,827,963 tons = 22.8 %
25.	Argentine Republic	839,660 tons	= 6.8 %	
26.	Chile	237,973 ,,	= 1.9 %	
27.	Brazil	155,074 ,,	= 1.2 %	
28.	Other South American countries	126,742 ,,	= 1.0 %	
	Total for South America			1,359,449 tons = 10.9 %
29.	Africa: Atlantic ports	591,922 tons	= 4.8 %	
30.	Union of South Africa	147,586 ,,	= 1.2 %	
31.	Africa: Indian Ocean and Red Sea ports	89,222 ,,	= 0.7 %	
32.	Africa: Mediterranean ports	78,865 ,,	= 0.6 %	
	Total for Africa			907,595 tons = 7.3 %
33.	South-west Asia and British India	1,038,567 tons	= 8.3 %	
34.	Far Eastern countries	414,963 ,,	= 3.3 %	
35.	Further India	269,520 ,,	= 2.2 %	
36.	Asia: Mediterranean, Black Sea, and Caspian Sea ports	82,991 ,,	= 0.7 %	
	Total for Asia			1,806,040 tons = 14.5 %
	Total for Australia			220,909 tons = 1.8 %

2. Sea-borne Imports (1925).

Classified according to Commodities.

Total figure: 12,429,262 tons.

Particulars concerning commodities:

1.	Coal and coke	2,455,000	tons	= 19.7 %
2.	Cereals	1,889,700	,,	= 15.2 %
3.	Oil fruit and oil seed	1,004,400	,,	= 8.1 %
4.	Mineral oils	905,000	,,	= 7.3 %
5.	Metals and Metalware	559,200	,,	= 4.5 %
6.	Fodder	477,200	,,	= 3.8 %
7.	Rice	455,200	,,	= 3.7 %
8.	Timber and wooden articles	412,600	,,	= 3.3 %
9.	Mineral earths and stones	398,200	,,	= 3.2 %
10.	Flour and flourmill produce	332,600	,,	= 2.7 %
11.	Manures	308,500	,,	= 2.5 %
12.	Fresh fruit	301,000	,,	= 2.4 %
13.	Ore	278,400	,,	= 2.2 %
14.	Oils and fats	262,100	,,	= 2.1 %
15.	Hemp, jute, and other vegetable fibres	218,600	,,	= 1.8 %
16.	Tanning material and extracts	217,200	,,	= 1.7 %
17.	Paper and paper goods	182,700	,,	= 1.5 %
18.	Hides and skins	169,600	,,	= 1.4 %
19.	Cellulose	129,600	,,	= 1.0 %
20.	Resins	118,600	,,	= 1.0 %
21.	Cotton and cotton waste	117,700	,,	= 0.9 %
22.	Cocoa	117,400	,,	= 0.9 %
23.	Meat	108,500	,,	= 0.9 %
24.	Coffee	96,700	,,	= 0.8 %
25.	Wool and waste wool	88,400	,,	= 0.7 %
26.	Fish	77,800	,,	= 0.6 %
27.	Asphalt	68,900	,,	= 0.6 %
28.	Raw tobacco	59,800	,,	= 0.5 %
29.	Chemicals	59,400	,,	= 0.5 %
30.	Machinery and machine parts	40,600	,,	= 0.3 %
31.	Miscellaneous articles	518,062	,,	= 4.2 %

3. Sea-borne Exports (1925).

Classified according to countries of destination.

Total figure: 6,961,537 tons.

Particulars concerning countries:

1.	United Kingdom	1,081,242	tons	= 15.5 %
2.	Germany	603,833	,,	= 8.7 %
3.	Denmark	601,210	,,	= 8.6 %

4.	Sweden	371,555 tons	= 5.2 %		
5.	Finland	257,373 ,,	= 3.7 %		
6.	Esthonia, Latvia, Lithuania	240,113 ,,	= 3.5 %		
7.	Norway	214,545 ,,	= 3.1 %		
8.	Russia	183,211 ,,	= 2.6 %		
9.	Netherlands	181,104 ,,	= 2.6 %		
10.	Spain	156,455 ,,	= 2.3 %		
11.	Italy	113,706 ,,	= 1.6 %		
12.	Danzig	108,210 ,,	= 1.6 %		
13.	Portugal	82,527 ,,	= 1.2 %		
14.	Belgium	59,416 ,,	= 0.9 %		
15.	Greece	42,734 ,,	= 0.6 %		
16.	Memel territory	20,741 ,,	= 0.3 %		
17.	France	19,216 ,,	= 0.3 %		
18.	Roumania	17,943 ,,	= 0.3 %		
19.	Bulgaria	16,084 ,,	= 0.2 %		
20.	Poland	9,743 ,,	= 0.1 %		
21.	Other European countries	5,670 ,,	= 0.1 %		
	Total for Europe			4,386,631 tons	= 63.0 %
22.	United States	700,826 tons	= 10.1 %		
23.	Central America and West Indies	111,130 ,,	= 1.6 %		
24.	Canada and Newfoundland	47,928 ,,	= 0.7 %		
25.	Mexico	38,457 ,,	= 0.5 %		
	Total for North and Central America			898,341 tons	= 12.9 %
26.	Brazil	265,238 tons	= 3.7 %		
27.	Argentine Republic	252,489 ,,	= 3.7 %		
28.	Chile	109,624 ,,	= 1.6 %		
29.	Other South American countries	191,817 ,,	= 2.8 %		
	Total for South America			819,168 tons	= 11.8 %
30.	Africa: Atlantic ports	122,431 tons	= 1.7 %		
31.	Africa: Indian Ocean and Red Sea ports	75,240 ,,	= 1.1 %		
32.	Union of South Africa	67,532 ,,	= 1.0 %		
33.	Africa: Mediterranean ports	806 ,,	= 0.0 %		
	Total for Africa			266,009 tons	= 3.8 %

34. Far Eastern countries	221,154 tons	= 3.2 %		
35. South-west Asia and British India	173,299 ,,	= 2.5 %		
36. Further India	83,460 ,,	= 1.2 %		
37. Asia: Mediterranean, Black Sea, and Caspian Sea ports	79,779 ,,	= 1.1 %		
Total for Asia			557,692 tons	= 8.0 %
Total for Australia			33,696 tons	= 0.5 %

4. Sea-borne Exports (1925). Classified according to commodities.

Total figure: 6,961,537 tons.
Particulars concerning commodities:

1. Manures	799,200 tons	= 11.5 %
2. Cereals and malt	722,100 ,,	= 10.4 %
3. Metals and metalware	585,800 ,,	= 8.4 %
4. Sugar	496,000 ,,	= 7.1 %
5. Paper and paper goods	404,400 ,,	= 5.8 %
6. Cement	341,900 ,,	= 4.9 %
7. Fodder	305,900 ,,	= 4.4 %
8. Chemicals and drugs	270,200 ,,	= 3.9 %
9. Rice	237,600 ,,	= 3.4 %
10. Timber and wood	228,600 ,,	= 3.3 %
11. Machinery and machine parts	185,600 ,,	= 2.7 %
12. Salt	180,600 ,,	= 2.6 %
13. Mineral oils	175,300 ,,	= 2.5 %
14. Oil fruit	174,400 ,,	= 2.5 %
15. Flour and flourmill produce	144,500 ,,	= 2.1 %
16. Cellulose	134,200 ,,	= 1.9 %
17. Mineral earths and stones	132,600 ,,	= 1.9 %
18. Glase and glassware	117,200 ,,	= 1.7 %
19. Potatoes	111,500 ,,	= 1.6 %
20. Dyestuffs, tanning material and extracts	85,500 ,,	= 1.2 %
21. Fresh fruit	69,600 ,,	= 1.0 %
22. Oils and fats	66,400 ,,	= 1.0 %
23. Textiles	64,900 ,,	= 0.9 %
24. Vegetable fibres	63,000 ,,	= 0.9 %
25. Coffee, cocoa, and tea	62,900 ,,	= 0.9 %
26. Porcelain, china, and earthenware	54,400 ,,	= 0.8 %
27. Beverages	48,200 ,,	= 0.7 %
28. Hides and skins	45,100 ,,	= 0.6 %
29. Miscellaneous articles	653,937 ,,	= 9.4 %

5. Incoming River-borne Traffic (1925).
Classified according to places of origin.

Total figure: 3,434,120 tons.
Particulars concerning places of origin:

1.	Elbe ports between Czechoslovak frontier and Magdeburg	1,353,775 tons	= 39.4 %
2.	Elbe ports in Czechoslovakia	641,755 ,,	= 18.7 %
3.	Ports on tributaries of the Elbe not separately enumerated	397,253 ,,	= 11.6 %
4.	Ports on the Havel, Spree, and other Brandenburg waterways	364,204 ,,	= 10.6 %
5.	Lower Elbe ports, i. e., ports between Hamburg and the mouth of the river	265,272 ,,	= 7.7 %
6.	Ports on the Oder and further east	194,785 ,,	= 5.7 %
7.	Elbe ports between Magdeburg and Hamburg	112,001 ,,	= 3.3 %
8.	Saale and Unstrut ports	105,075 ,,	= 3.0 %

6. Incoming River-borne Traffic (1925).
Classified according to commodities.

Total figure: 3,434,120 tons.
Particulars concerning commodities:

1.	Stones and mineral earths	788,000 tons	= 22.9 %
2.	Manures	549,000 ,,	= 16.0 %
3.	Sugar	522,000 ,,	= 15.2 %
4.	Paper and paper goods	208,000 ,,	= 6.1 %
5.	Timber and wood	195,000 ,,	= 5.7 %
6.	Salt	192,000 ,,	= 5.6 %
7.	Pit coal, lignite, and coke	174,000 ,,	= 5.1 %
8.	Cereals	133,000 ,,	= 3.9 %
9.	Glass and glassware	85,000 ,,	= 2.4 %
10.	Iron and hardware	78,000 ,,	= 2.3 %
11.	Flour and flourmill produce	48,000 ,,	= 1.4 %
12.	Machinery	40 000 ,,	= 1.2 %
13.	Soda	26,000 ,,	= 0.8 %
14.	Cables	25,000 ,,	= 0.7 %
15.	Beverages	23,000 ,,	= 0.7 %
16.	Malt	22,000 ,,	= 0.6 %
17.	Ore	22,000 ,,	= 0.6 %
18.	Caustic potash	22,000 ,,	= 0.6 %
19.	Chemicals and drugs	22,000 ,	= 0.6 %
20.	Fruit	19,000 ,,	= 0.6 %
21.	Miscellaneous articles	241,120 ,,	= 7.0 %

7. Outgoing River-borne Traffic (1925).
Classified according to destinations.

Total figure: 3,305,077 tons.
Particulars concerning destinations:

1.	Elbe ports between Czechoslovak frontier and Magdeburg	1,110,651 tons	= 33.5 %
2.	Ports on the Havel, Spree, and other Brandenburg waterways	992,688 ,,	= 30.0 %
3.	Elbe ports in Czechoslovakia	478,390 ,,	= 14.4 %
4.	Ports on the Oder and further east	279,589 ,,	= 8.6 %
5.	Lower Elbe ports, i. e., ports between Hamburg and the mouth of the river	214,027 ,,	= 6.6 %
6.	Elbe ports between Magdeburg and Hamburg	80,004 ,,	= 2.4 %
7.	Saale and Unstrut ports	76,948 ,,	= 2.3 %
8.	Ports on tributaries of the Elbe not separately enumerated	72,780 ,,	= 2.2 %

8. Outgoing River-borne Traffic (1925).
Classified according to commodities.

Total figure: 3,305,077 tons.
Particulars concerning commodities:

1.	Cereals	716,000 tons	= 21.7 %
2.	Pit coal and coke	407,000 ,,	= 12.3 %
3.	Mineral oils	237,000 ,,	= 7.2 %
4.	Ore	179,000 ,,	= 5.4 %
5.	Flour and flourmill produce	143,000 ,,	= 4.3 %
6.	Oil fruit and oil seed	139,000 ,,	= 4.2 %
7.	Oils and fats	111,000 ,,	= 3.4 %
8.	Copper	106,000 ,,	= 3.2 %
9.	Stones and mineral earths	98,000 ,,	= 3.0 %
10.	Iron and hardware	90,000 ,,	= 2.7 %
11.	Phosphate of lime	87,000 ,,	= 2.7 %
12.	Timber and wood	84,000 ,,	= 2.5 %
13.	Sugar	66,000 ,,	= 2.0 %
14	Chile saltpetre	60,000 ,,	= 1.8 %
15.	Rice	57,000 ,,	= 1.7 %
16.	Jute	56,000 ,,	= 1.7 %
17.	Lead	50,000 ,,	= 1.5 %
18.	Oilcake	44,000 ,,	= 1.3 %
19.	Fresh fruit	40,000 ,,	= 1.2 %
20.	Asphalt	40,000 ,,	= 1.2 %
21.	Cocoa	33,000 ,,	= 1.0 %
22.	Cotton	24,000 ,,	= 0.7 %

23. Hides and skins	23,000 tons	= 0.7 %
24. Tanning material	15,000 ,,	= 0.5 %
25. Coffee	16,000 ,,	= 0.5 %
26. Miscellaneous articles	384,077 ,,	= 11.6 %

9. Incoming Rail-borne Traffic (1926).[1]

Total figures: 8,495,000 tons and 505,000 heads of cattle.

Particulars concerning method of transport (excluding cattle):

1. Package Goods	380,000 tons	= 4.5 %
2. Carloads	8,115,000 ,,	= 95.5 %

Particulars concerning arrival stations (excluding cattle):

1. Berliner Bahnhof	4,151,000 tons	= 48.8 %
2. Hamburg-Süd Station	2,960,000 ,,	= 34.9 %
3. Barmbeck Station	460,000 ,,	= 5.4 %
4. Sternschanze Station	361,000 ,,	= 4.3 %
5. Kai-rechts Station	314,000 ,,	= 3.7 %
6. Lübeck-Büchen Railroad Station	102,000 ,,	= 1.2 %
7. Shed for express goods	82,000 ,,	= 1.0 %
8. Ohlsdorf Station	65,000 ,,	= 0.7 %
9. Hannoverscher Bahnhof	(No arrivals).	

Number of freight cars arriving: 740,000.

10. Outgoing Rail-borne Traffic (1926).

Total figures: 2,774,000 tons and 152,000 heads of cattle.

Particulars concerning method of transport (excluding cattle):

1. Package goods	329,000 tons	= 12 %
2. Carloads	2,445,000 ,,	= 88 %

Particulars concerning departure stations (excluding cattle):

1. Hamburg-Süd Station	1,312,000 tons	= 47.3 %
2. Kai-rechts Station	366,000 ,,	= 13.2 %
3. Hannoverscher Bahnhof	365,000 ,,	= 13.2 %
4. Berliner Bahnhof	349,000 ,,	= 12.6 %
5. Lübeck-Büchen Railroad Station	174,000 ,,	= 6.2 %
6. Shed for express goods	103,000 ,,	= 3.7 %
7. Sternschanze Station	61,000 ,,	= 2.2 %
8. Barmbeck Station	42,000 ,,	= 1.5 %
9. Ohlsdorf Station	2,000 ,,	= 0.1 %

Number of freight cars leaving: 389,000.

---

[1] No 1925 figures are available for the rail-borne traffic.

11. Sea-borne Imports and Exports.
Classified according to methods of transhipment.

Percentage figure shewing quantities of goods loaded and discharged:

Year	In state-operated quay sheds:	In sheds leased to shipping companies:	On state-operated and leased quays together:	On *Freiladekais* and in midstream (including some warehousing and industrial plants):
1913	16 %	12 %	28 %	72 %
1922	19 %	12 %	31 %	69 %
1923	16 %	10 %	26 %	74 %
1924	17 %	13 %	30 %	70 %
1925	18 %	13 %	31 %	69 %
1926	15 %	11 %	26 %	74 %

Quantities and percentage figures shewing goods transhipped:

Year	In quay sheds (state and privately-operated):	On *Freiladekais* (between ship and railroad direct):	On all quays:	In midstream (including some warehousing and industrial plants):
		(a) Incoming Traffic.		
1923	3,251,000 tons = 23 %	1,748,000 tons = 12 %	4,999,000 tons = 35 %	9,159,000 tons = 65 %
1924	3,942,000 tons = 30 %	422,000 tons = 3 %	4,364,000 tons = 33 %	8,620,000 tons = 67 %
1925	4,246,000 tons = 34 %	112,000 tons = 1 %	4,358,000 tons = 35 %	8,071,000 tons = 65 %
1926	3,684,000 tons = 33 %	65,000 tons = 1 %	3,749,000 tons = 34 %	7,292,000 tons = 66 %
		(b) Outgoing Traffic.		
1923	1,977,000 tons = 29 %	58,000 tons = 1 %	2,035,000 tons = 30 %	4,739,000 tons = 70 %
1924	1,817,000 tons = 28 %	72,000 tons = 1 %	1,889,000 tons = 29 %	4,656,000 tons = 71 %
1925	1,794,000 tons = 26 %	92,000 tons = 1 %	1,886,000 tons = 27 %	5,076,000 tons = 73 %
1926	1,866,000 tons = 17 %	1,134,000 tons = 10 %	3,000,000 tons = 27 %	7,870,000 tons = 73 %

Table shewing percentage figures of the incoming goods traffic handled on the state-operated quays (quay sheds only) and taken over by:

Year	Lighters	Barges	Coastal Vessels	Railroad	Carts
1906	54 %	13 %	1 %	20 %	12 %
1907	53 %	14 %	1 %	20 %	12 %
1908	51 %	14 %	1 %	21 %	13 %
1909	50 %	16 %	1 %	20 %	13 %
1910	52 %	16 %	2 %	18 %	13 %
1911	50 %	10 %	2 %	25 %	13 %
1912	49 %	13 %	2 %	24 %	12 %
1913	54 %	12 %	2 %	19 %	13 %
1921	41 %	8 %	2 %	31 %	18 %
1922	43 %	8 %	3 %	30 %	16 %
1923	41 %	7 %	2 %	32 %	18 %
1924	34 %	9 %	3 %	25 %	29 %
1925	39 %	11 %	2 %	24 %	24 %
1926	39 %	10 %	3 %	22 %	26 %
1906/13 average	51.6 %	13.5 %	1.5 %	20.9 %	12.5 %
1921/26 average	39.5 %	8.8 %	2.7 %	27.3 %	21.7 %

Table shewing percentage figures of the outgoing goods traffic handled on the state-operated quays (quay sheds only) and arriving there by:

Year	Lighters	Barges	Coastal Vessels	Railroad	Carts
1906	7.23 %	0.08 %	0.06 %	31.90 %	60.73 %
1907	6.70 %	0.06 %	0.07 %	35.00 %	58.17 %
1908	5.22 %	0.07 %	0.03 %	34.40 %	60.28 %
1909	4.89 %	0.04 %	0.06 %	32.20 %	62.81 %
1910	6.70 %	0.10 %	0.07 %	19.35 %	73.78 %
1911	5.30 %	0.07 %	0.03 %	32.60 %	62.00 %
1912	5.82 %	0.06 %	0.02 %	34.00 %	60.10 %
1913	5.00 %	0.14 %	0.01 %	32.50 %	62.35 %
1921	3.78 %	—	—	58.60 %	37.62 %
1922	5.27 %	—	—	45.90 %	48.83 %
1923	3.80 %	—	—	51.00 %	45.20 %
1924	5.00 %	—	—	49.00 %	46.00 %
1925	4.75 %	—	—	50.00 %	45.25 %
1926	5.72 %	—	—	54.00 %	40.28 %
1906/13 average	5.96 %	—	—	31.49 %	62.55 %
1921/26 average	4.72 %	—	—	51.42 %	43.86 %

B. Some Distances, Measurements, and Areas pertaining to the Port of Hamburg.

1.	Distance between Hamburg and Elbe I Lightship	86 miles
2.	Distance between Hamburg and Cuxhaven	64 ,,
3.	Width of Elbe near Elbe Bridges	1,000 feet
4.	Width of Elbe near Finkenwärder	2,000 ,,
5.	Depth of Elbe near Hamburg (below M. H. W.)	40 ,,
6.	Greatest length of Harbour Area (measured in midstream)	9 miles
7.	Size of Harbour Area including industrial areas in the Free Port, Peute, and Billwärder-Moorfleth accessible by open canals	10,000 acres
	Size of Free Port area only	3,340 ,,
	Part of Harbour Area covered by land	5,900 ,,
	Ditto: Free Port only	1,500 ,,
	Part of Harbour Area covered by water	4,100 ,,
	Ditto: Free Port only	1,840 ,,
8.	Total area (water spaces only) occupied by basins for sea-going ships	1,250 ,,
	Ditto: Free Port only	1,020 ,,
	Ditto: Customs Union territory only	230[1] ,,
9.	Total area (water spaces only) occupied by basins for rivercraft	860 ,,
	Ditto: Free Port only	375 ,,
	Ditto: Customs Union territory only	485[2] ,,
10.	Total length of water frontage (with and without quay walls)	105 miles
	Ditto: Free Port only	50 ,,
11.	Depth of water below M. H. W. in the basins for sea-going ships	24, 25, 26, 27, 30, 32, 36 feet
12.	Depth of water below M. H. W. in the basins for rivercraft	13, 15, 17, 18, 20, 22 feet
13.	Mean difference between high and low water at Hamburg	$6^1/_2$ feet
	Mean difference between high and low water atCuxhaven	$9^1/_2$,,

---

[1] This figure is inclusive of Griesenwärder Hafen (80 acres) now in course of construction which will ultimately be incorporated with the Free Port. By the time of printing (April 1927) it still forms part of the Customs Union territory.

[2] The areas covered by Billwärder Bucht (300 acres) and the rivercraft portion of Griesenwärder Hafen ($9^1/_2$ acres) have been included in this total.

★

C. Details concerning some Harbour Constructions and Mechanical Installations.

1. Length of quayage in the basins for sea-going vessels	20½ miles
Ditto: Free Port only	18½ ,,
2. Length of quayage in the basins for rivercraft	10 ,,
Ditto: Free Port only	3½ ,,
3. Length of berthing accommodation at dolphins	
(a) For sea-going ships	19½ ,,
Ditto: Free Port only	16½ ,,
(b) For rivercraft	24 ,,
Ditto: Free Port only	11½ ,,
4. Number of state-built quay sheds	86
Total length	11 ,,
Area of covered floorspace	154 acres
Ditto: In State-operated quay sheds only	87 ,,
5. Total area of covered floorspace in warehouses (approximately)	200 ,,
Ditto: Freihafen-Lagerhaus-Gesellschaft only	126 ,,
6. Number of public and private hoisting appliances available for transhipment purposes	1915
This number includes:	
(a) Stationary cranes on shore for very heavy loads	10
(b) Travelling quay cranes on the water side of quay sheds and on *Freiladekais*	916
Of these, there are double cranes	44
triple cranes	3
(c) Stationary cranes near quay sheds and on *Freiladekais*	178
(d) Hoisting apparatus in and on other buildings, e.g., customhouse stations, warehouses, etc.	630
(e) Floating steam winches	123
(f) Floating cranes	22
(g) Floating grabs	8
(h) Floating coal elevators	6
(i) Floating grain elevators	22
7. Number of coal tipping devices	5
8. Length of Port of Hamburg Railway tracks	227 miles
Ditto: Right bank of the Elbe only	45 ,,
Ditto: Left bank of the Elbe only	182 ,,
9. Length of customs palisades on shore	16½ ,,
Length of floating palisades	1 mile
10. Number of locks	6
11. Number of landing places	272
12. Number of customhouse stations	41
13. Number of mooring posts	8,900
14. Number of bridges in the Harbour Area	86

Date Due

TC274 .H3W4

Wendemuth, Ludwig

The port of Hamburg.

82503

82503

TRENT UNIVERSITY
1